EDITORIAL

THE famous La Brea asphalt pits on the outskirts of Los Angeles have been given to the city for a public park. No restrictions are made by the former owners, except that the land shall be maintained as a park and a small museum established. This is an excellent opportunity for starting a comprehensive museum of California petroleum.

IN this issue will begin a series of articles on Timber Framing, prepared by Mr. Henry D. Dewell. Mr. Dewell was formerly chief construction engineer for the Panama-Pacific Exposition, and in that capacity had occasion to design many of the largest timber structures that have ever been built. Mr. Dewell has incorporated his experience and research work in the series of papers that will follow. We feel sure that our readers will appreciate the benefits to be derived from a careful perusal of these articles.

HIGHWAY maintenance admittedly is a serious problem every year. A certain road supervisor of southern California is having more than his share of trouble. His district is in the desert section, large in area and sand, and short of population and money. Funds available are too small to permit laying any sort of permanent pavement, and it has been a severe tax upon the ingenuity of the road supervisor to provide even the verisimilitude of a road. On one aggravatingly sandy section, cotton seed, as a waste product from the gins, was tried as a surfacing-material. This was reasonably successful until a band of sheep put in appearance and swallowed the road whole. Now some friendly critic with an ingrowing sense of humor has suggested tin cans as an alternative, but the burros of the desert are known to be not merely herbivorous but omnivorous, and it is feared that the motorists in this section of the sunny south will have to contend still with billows of sand, which at least are sufficiently indigestible to act as a deterrent to the appetite of the fauna that are indigenous to the soil.

JAMES JEROME HILL is dead. It has been said that he was worth anywhere from $100,000,000 to $250,000,000. Such estimates are based upon a narrow viewpoint, and are far too low. To convert his worth to the Pacific Northwest or to the United States into dollars, is impossible. We have had no finer example of an American. He started at the bottom and ended his career at the pinnacle of success. He was probably the first great railroad builder and operator to preach and practice two great principles, which since have become axiomatic. The first was, in effect, that the prosperity of a railroad and of the region which it serves are indissolubly connected and that it is to the best interests of the railroad to foster and build up that prosperity, looking to the future rather than the present for immediate financial returns. The second principle is that efficient railroad operation requires low grades, heavy locomotives and cars, and large trains. While the great fortune that Mr. Hill accumulated during his lifetime will soon be forgotten, the work that he did as a pioneer, a builder, and a creator, will keep his name alive as long as there are railroads.

IN another column we print a letter regarding certain aspects of the convict-labor question. Our correspondent's viewpoint is natural, but we believe it to be a mistaken one. It is a fact known and recognized by most penologists that the great majority of convicts have never become proficient at any honest work and that whatever "years of training" they may have had has been along lines which the State is doing its best to discourage. Before the kind of honest employment for which any single convict is fitted can be determined, it is necessary both that the man should be observed carefully while at work, and that he should in some measure 'find himself.' Hard physical labor in the open air and where, in particular, the man can see a tangible result of his work, even if it be only ten yards of improved highway, may assist mightily in both these objects. In this way the energy and initiative that the man "has thrown into his crime may be turned into the right channel." As far as the competition with free labor is concerned, we have stated before our reasons for believing that this competition will be confined to a small number of unskilled laborers, and that the skilled highway-worker will be unaffected. We believe the implication that private persons are likely to benefit as a result of the use of convict labor in this State is unfounded. Commercial exploitation of such labor would be a great evil, but it can be prevented easily when the occasion arises. Meanwhile, let us be thankful that a way has been found to construct the much-needed mountain laterals of the State Highway.

MEASURES providing some form of relief for the holders of unpatented oil land now seem to have a fair chance for receiving the approval of Congress. The principal opponent of the measures proposed seems to be Mr. Josephus Daniels, Secretary of the Navy, who is strenuously against any measure which may provide for the extension of any favors to oil operators within the so-called naval reserves, on the ground that all land within such reserves should be retained by the Govern-

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ment as a source of supply for the Navy. As the crude oil produced from these lands is too light for fuel purposes, the Government could not take due advantage of ownership unless it went into refining as well as the producing business. Worshipers of the fetish of Government ownership seem to regard it as a panacea for all ills. We would venture the opinion that if accurate cost-keeping methods were employed in the various enterprises in which the Government has already ventured, that a series of shocks would be experienced by many of the most pronounced advocates of Government ownership. It has been stated that if the Navy is forced to rely altogether upon ordinary commercial sources for its supply of oil that the cost would be very great. This view, however, hardly checks up with the fact that Uncle Sam buys practically everything from transportation to foodstuffs at notoriously lower prices than are offered any private consumer. Incidentally, this is equally true of labor, especially skilled.

Preparedness and the Engineer

Military preparedness is fast becoming epidemic, and it is to be hoped that something real may be accomplished before the present enthusiasm has abated. All sorts and conditions of schemes have started, so many in fact that the average man is confused and bewildered at the multiplicity of bids for his support.

First, of course, came the Naval Advisory Board, now known as the Naval Consulting Board, an idea of such obvious excellence that one wonders why it had never been thought of before. This was followed by the military training camps for civilians, inaugurated in the summer of 1915 as a sort of experiment. So successful were those held at Plattsburg, Fort Sheridan, and San Francisco that this summer the same training on a more elaborate scale will be given to thousands of volunteers all over the country. Employers are lending their hearty co-operation to this movement, and are giving to as many of their employees as can be spared not merely leave of obsence to attend the encampments but full salary as well.

Next came the extension of the Naval Consulting Board through the co-operation of the five national engineering societies. One representative of each was appointed for each State. Each State group constitutes a board of directors, their specific work being the compilation of a complete census of the industrial resources of the United States with respect to the manufacture of munitions in time of war. Mr. Babcock's paper in this issue shows how important this work is, and how this work may be accomplished through the organization of the entire body of civilian engineers under the direction of the State Boards. Industrial preparedness is the foundation upon which success in the field depends.

The next step, if our understanding of the chronology of events is correct, came the Smedberg plan, local, as far as California is concerned, calling for the organization of an engineer corps of volunteers. In previous issues we have discussed in general the plan of organization, appointment of temporary officers and headquarters, so these need not be considered at this writing. In pursuit of his plan, Mr. Smedberg has received the unofficial backing of regular army officers stationed in San Francisco, notably Lieutenant Colonel Rees and his aide Captain Park. An excellent skeleton organization has been built up, and seems in a fair way to take on flesh rapidly, judging by the success that has thus far attended the efforts of the recruiting officers.

With the idea of providing ways and means for insuring active co-operation with the directors of the State Naval Consulting Board, committees have been appointed by the local executive committees of the five engineering societies. In addition, these committees, acting jointly, are preparing plans for the guidance of their members in participating actively in the whole scheme of preparedness in whatever capacity they are best qualified.

In the meantime, Congress has passed the army bill, increasing the peace strength of the regular army; providing for a Federalized State militia; and providing for carrying on the annual civilian military training camps at the expense of the Federal Government. At present writing, particulars as to the provision made for the training of volunteer or reserve officers are not obtainable.

Here, then, is the quandary in which many civilian engineers find themselves. Practically all of them would like to do something, anything, for the good of their country, but what? Of the various means offered above for the expenditure of one's surplus time and energy, only one has any official standing. The others seem almost as ineffective as a shot in the dark with both eyes closed; they start nowhere, end nowhere, and hit nothing. All of this sporadic training, summer encampments and the like, lack a definite objective, without which, many of the best engineers will feel inclined to hold back until they know what the Government itself offers in the way of official recognition, after any prescribed course of training has been carried out.

In the absence of full particulars as to the provisions of the army bill, it is futile to attempt to discuss it. Nevertheless, means are undoubtedly provided for the training of volunteer or reserve officers in some way or other, whether through becoming a part of the State militia or through the establishment of schools in charge of regular army officers. The various movements that have been started prior to any official action on the part of the Government have this undoubted merit; they will have saved an appreciable amount of time, and will have a fairly compact body of men ready to go to work when the Government decides as to the ways and means.

The engineer is a busy, hard-working man. He is generous to a fault with his time and money. He does his share and more of the world's work. He is the pioneer in every constructive enterprise, and is the first to volunteer in time of need. But he is opposed to waste of time or effort, and will be inclined to inquire where he is going to land before he jumps off the fence.

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REVIEW OF THE MONTH

AFTER five years of continuous work, the United States reclamation project known as the Elephant Butte dam, has been completed. The dam is in New Mexico, on the Rio Grande river, about 120 miles from El Paso. The reservoir is the largest in the world and will impound water in quantities sufficient for the irrigation of 185,000 acres of semi-arid land in Texas and New Mexico.

OIL production in April was approximately 245,000 barrels per day, showing only a slight increase over March. Shipments, on the other hand, were the greatest of any month since the outbreak of the War, so that 1,400,000 barrels were drawn from stocks. There are rumors of another increase in the price of crude oil at the well. Higher price for casing and other steel products, however, are taking a large slice out of the oil-operator's increased receipts.

THE General Petroleum Company is following the prevailing fashion and preparing for reorganization. The plans proposed provide for a considerable reduction in the paper value of the outstanding securities and are said to be satisfactory to all interested parties. The old company owned a large acreage of valuable oil territory, both developed and undeveloped, and with conditions in the oil industry steadily improving, the reorganized company should find smoother sailing than its predecessor.

WHILE 'watchful waiting' in Mexico grows more watchful and less waiting day by day, one important peaceful achievement has just been completed by the co-operation of the governments of the United States and of Mexico. This is the connection of the triangulation systems of the two countries. The arc of primary triangulation extends from the north-western part of Minnesota southward along the 98th meridian to the Rio Grande and thence through Mexico to the Pacific coast. The total length of the arc is 2270 miles.

'CEMENT TIES' is the scarehead of a newspaper item that appeared recently in the daily press. Having in mind the experimental work being conducted in attempting to produce railroad-ties with portland cement as the chief ingredient, the engineer would eagerly scan the words following. However, it appears that the ties in question are those alleged to exist between the United States and Japan. While no particulars are given as to the brand of cement used for effecting this happy consummation, it would appear, to the engineer at least, that cement in tension is not overstrong, and we hope that diplomatic contractors who have undertaken this job at Washington will keep this in mind and be governed accordingly in the course of their deliberations.

THE General Land Office has rendered a decision clearing up the ambiguity of land titles in a part of the Imperial valley. It will be remembered that when the reclamation of the valley commenced, all reliable records of the original public-land survey made in 1856 had disappeared, which is a phenomenon quite common to the desert regions of the West. Settlers upon Imperial valley lands went ahead as best they could, but soon found that uncertainty as to title had been added to their many other troubles The Land Office has now cleared this up to the general satisfaction of all those concerned, and as a result the Imperial valley may look forward to a more rapid development of its many resources.

WESTERN PACIFIC RAILROAD is to be sold under foreclosure on June 28, an 'upset' price of $18,000,000 having been fixed by the Federal Court. This is a virtual victory for the majority bondholders, who wanted a price of $15,000,000 fixed, while the minority were in favor of $40,000,000. It is probable that the reorganization program of the majority bondholders will be carried out, including the purchase of needed equipment and the expenditure of a considerable sum on betterments and 'feeder' lines. The system cost $77,000,000 to build and is now earning about about $1,000,000 annually over taxes, maintenance, and operating expenses. Many of the strongest railroad systems of the West have passed through similar difficulties and there is every reason to believe that the Western Pacific will soon be on a sound financial footing.

GOOD-ROADS construction received a set-back in San Diego county last month. A bond issue was proposed, calling for the expenditure of $1,000,000 to provide a system of concrete highways, and another for approximately the same sum for repair and reconstruction of highways and bridges damaged by storms last winter. Both of these issues were defeated by large majorities. There seems to have been a feeling among the voters that the work was planned hastily, too hastily in fact for careful study and consideration to estimates, specifications and other provisions, and especially that large expenditures were provided at points where they were not required. It is likely that, had the work of planning been undertaken with greater care with respect to location, the bond issues would have been approved. The

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good-roads advocates should not be discouraged at this temporary reversal, but should go at it again in such a way as to eliminate the objections raised toward the first plan. The defeat of the bonds to provide funds for repairing roads and bridges damaged by storms, does not indicate that the citizens of San Diego intend to leave the remains of their roads and bridges in their present state of dilapidation. Funds for making necessary repairs will be available from the regular tax-levy after July 1.

PLANS are being considered by the water users in the San Joaquin valley for the formation of an irrigation district containing a large part of Fresno and Kings counties, as well as some land in Tulare county. The total area of the proposed district is somewhat more than 1,100,000 acres, of which 600,000 acres are now under irrigation from the Kings river. Part of this land has first-class water rights; the remainder has second-class water rights, which can be exercised only after the owners of first-class rights have been satisfied. The Alta irrigation district is serving a portion of the land, while the remainder is provided with water by various other companies, the duty of water in the region being about one second-foot to 160 acres. The first-class lands, as a general rule, get all the water they require during wet seasons. Second-class lands also fare reasonably well at such times. In dry years, however, a supply sufficient for the first-class land has to be carefully conserved during the summer months, and is likely to fail entirely by early fall, while the second-class lands receive little or no water, under such circumstances. The project proposed is primarily a conservation measure, and by the construction of a reservoir in the mountains, at an estimated cost of $6,000,000, for the purpose of impounding 600,000 acre-feet, it is believed that sufficient water can be insured for all of the land now irrigated. In addition, the present unirrigated land within the proposed district can also be served. It is proposed to assess the cost of the project against the lands included in the district in proportion to the benefits derived, the cost varying from $1.50 per acre for land with a first-class right, to $15 per acre for some of the land at present unirrigated. One of the incidental, and by no means least important, results of constructing the proposed reservoir would be an improved means for flood-control on Kings river, particularly with reference to the Tulare-lake lands. It is also probable that those in charge of the formation of the district will take means to line their present earth ditches with concrete and thus save the large quantity of water lost through seepage.

EVERYBODY has heard of the man who was not broke, but was merely badly bent. It appears, however, from testimony by Mr. William Clayton, vice-president and managing director of the Spreckels companies, that the San Diego & Southwestern Railroad is both broke and bent, the latter condition applying to the trackage upon the right-of-way after the floods of last winter. Mr. Clayton informed the Railroad Commission that the railroad has accumulated a deficit of $115,000 and that it has not paid operating expenses during the past two years. The stockholders, naturally, while expressing the most patriotic desire to serve the public in every way possible, have felt that the limit is reached and are averse to digging into their pockets to provide funds for further operations. The Commission, thereupon, sat back and looked wise while an exchange of pleasantries took place between Mr. Paul Thelan, engineer for the Commission, and Mr. Andrew Ervast, engineer for the Spreckels companies, while Mr. Thelan presented thirteen hypothetical solutions for Mr. Ervast to masticate and then struggle to digest. It was brought out at the hearing that the Commission had consented to an increase in the company's rates. This consent, however, was given before the recent flood, and was followed by the usual protest from shippers; but since the law permits any utility to charge rates that will make possible the earnings of a reasonable interest on its investment, the Commission had to disregard the wails of the shippers. There is a general impression among the uninitiated, and a few who should be initiated, that railroad operation and dividends are synonymous, in spite of the fact that at present writing a very large proportion of American railroads is in the hands of receivers. The shippers are quite as badly in need of education on various points of railroad economics as the railroads once were on the interests of the shippers. Each needs the other, and there is a sane middle ground that will provide service for shippers at reasonable rates and at the same time will permit the railroads to make a reasonable profit for their stockholders. The shippers in the territory tributary to the San Diego & Southwestern railroad are in a fair way to get their education. They seem to have awakened to the fact that the flood has accomplished in a short time what low rates was in a fair way to accomplish in the end, and that is, to have put the railroad out of business. They now seem quite willing to have the railroad rebuilt, more than willing to have the Railroad Commission establish rates that will not pay the railroad a profit, but at the same time most unwilling to subscribe to a bond issue that will permit the rebuilding of the railroad in order that it may serve them. Some of the shippers were inclined to encourage the establishment of a jitney freight service, provided the State would furnish the shippers with concrete roads over which the jitneys could make rapid time. In fact, one shipper admitted that he, himself, had ridden in a jitney "for his own convenience." Another shipper discovered that the railroad officials themselves commuted from their offices to their homes in their own automobiles instead of riding in the company's railroad trains, which must have had a very serious effect upon the gross earnings of the railroad. What the outcome will be is hard to foretell, but it is interesting nevertheless to observe the spectacle of an aggregation of shippers who suddenly find themselves without facilities and who desire them restored at the expense of someone else.

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DISCUSSION

The Shields Water-Power Bill

The Editor:

Sir—Mr. Gifford Pinchot, former Chief Forester of the United States, addressed to you on February 15, 1916, a letter urging you to oppose actively Senate Bill 3331, commonly known as the Shields Bill, relating to hydro-electric development in navigable streams.

The bill safeguards fully every public interest developed and defined during ten years of public inquiry and discussion. No permit can be issued until the Secretary of War is satisfied, after examination, that the plans, specifications and situation are such as are adapted to "a comprehensive plan for improvement of the waterway in question, for the uses of navigation, and for the full development of its water power and for other beneficial public purposes." The mere holding of permits without development and use, possibly to prevent competition, is effectively prevented by stringent requirements relating to the time for beginning and completing construction of the necessary works. The system provided by the bill for the regulation of rates, charges, and service, a subject of prolonged controversy, recognizes fully the rights and duties of the States and the Federal Government and insures co-operation, not conflict.

Mr. Pinchot asserts that the Shields Bill—

> "gives the use of enormously valuable public property to the water-power interests without compensation."

If by this Mr. Pinchot means that no Government tax for revenue purposes is imposed on the enterprise, he is correct. Such a tax would merely be a tax on the consumer of power, since it would be one of the elements necessarily involved in making the rates. Because this has been fully realized, the idea of raising Government revenue from water power development has been abandoned by most of its early advocates. But it is wholly untrue that the Shields Bill gives the use of enormously valuable public property "without compensation."

Section 2 of the bill, the section authorizing the permit, empowers the Secretary of War to require that the "grantee shall, to the extent necessary to preserve and improve navigation facilities at least equivalent to those existing prior to the construction of such dam, construct, in whole or in part, without expense to the United States, in connection with any such dam, a lock or locks, booms, sluices, or other structures for navigation purposes, in accordance with plans, specifications, and conditions approved by the Secretary of War and made a part of such permit."

The same section also provides that "in case such navigation facilities shall not be made a part of such original construction * * * then, whenever the United States shall deem such navigation facilities necessary the grantee shall convey to the United States, free of cost, such of its land and its right of way and such right of passage through its dams or other structures, and permit such control of pools as may be required for such navigation facilities, and shall furnish free of cost, power for the operation of the same" and also that "such grantee shall pay to the United States reasonable charges in consideration of the benefits accruing to and used by such grantee through the construction, operation, and maintenance by the United States of headwater improvements, including storage reservoirs."

Mr. Pinchot also asserts that the Shields Bill—

> "has been so drawn as to make it practically impossible for the people to take their own water powers back into their hands."

Section 6 of the bill contains a clear, practicable and effective plan for "recapture" after fifty years, the term of the permit. Under this section the United States may terminate the rights of the grantee after fifty years upon the taking over by the United States of all the property of the grantee which constitutes part of the plant and is dependent, in whole or in part, upon it for its usefulness and so acquired, or is necessary, appurtenant, valuable or serviceable in the distribution of water or in the generation, transmission and distribution of power, and upon paying to the grantee the fair value of the property taken and assuming contracts previously made under Government sanction. By a further provision of this section, the United States is permitted not only to terminate the permit and take over the property for its own use, but also for the use of a subsequent permittee.

Mr. Pinchot also asserts that the Shields Bill—

> "interposes every possible legal delay between the violation of a Government permit and the chance of effective enforcement."

Section 8 of the bill imposes a fine of $1000 for every violation by a permittee of the provisions of the act, or of any of the conditions of the permit or of any lawful regulations or orders of the Secretary of War; confers special jurisdiction upon the United States District Courts summarily to enforce such provisions, conditions, regulations, and orders; and in case of persistent violation, authority is given for a decree revoking all rights and privileges granted under authority of the act.

Mr. Pinchot also asserts that the Shields Bill—

> "fails to require the necessary publicity and uniformity of accounts, and so makes the effective supervision of water-power corporations impossible."

Section 7 of the Bill makes provision for exactly what Mr. Pinchot asserts is lacking, in the following language:

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"The Secretary of War shall have the right to provide rules and regulations for uniform accounting, to examine all books and accounts of grantees under the terms of this Act, to require them to submit statements, representations or reports, annual or special, including full information as to assets and liabilities, capitalization, cost of project, cost of operation, the production, use, transmission and sale of power. All such statements, representations, and reports shall be upon oath unless otherwise specified, and in such form and on such blanks as the Secretaries may require, and any person making any false entry, statement, representation, or report under oath shall be subject to punishment as for perjury."

Mr. Pinchot also asserts that the Shields Bill—

> "gives to the water-power interests the right to condemn or take any land they choose."

This charge is contradicted by the provisions of subdivision two of section 2 of this bill, requiring that the Secretary of War be first satisfied regarding the qualifications of the grantee and the appropriateness of the project before construction is begun.

Mr. Pinchot also asserts that the Shields Bill—

> "forces the people, when they take back the public property whose use they have granted, to pay the unearned increment on land condemned or otherwise acquired by the grantee."

What the people "take back" upon recapture is something very different from "the public property whose use they have granted." It is the latter, together with all the plant that has been built up out of fifty years' investment of private investors.

For "the public property whose use they have granted," the people pay absolutely nothing upon recapture. In the words of the bill: "no value shall be claimed by or allowed to the grantee for the rights hereunder granted."

But for the property acquired and built up out of the investors' own money, the United States, when it takes it over, must pay to the grantee "the fair value." To call the value accruing to this property after fifty years' investment an "unearned increment" is to stigmatize this form of investment with a term that is absolutely a misnomer. With "the rights hereunder granted" forever eliminated from the value of the property, there remains no "unearned increment" whatsoever.

This is all that is meant by paying "fair value."

Without unfairness to Mr. Pinchot, it is submitted that the above presentation of facts shows his assertions with reference to the Shields Bill to be incorrect and misleading.

Yours very truly,

H. W. Hand,
Calvert Townley,
W. W. Nicols,
Chester W. Larner,
J. E. Way,
Executive Committee Water Power Development Association.

Washington, D. C., May 1.

Convict Labor on Highway Construction

The Editor:

Sir—There is a feature of the employment of convict-labor on State work, which I think, is one that should be brought strongly to your attention, not alone to your attention but to the attention of every citizen who is interested in the welfare of his fellow-man.

The idea that convict-labor is a great economic gain is a fallacy. A man who has been trained and has specialized in some one particular craft or profession commits a felony and is sent to prison. How absurd to take this man, with an utter disregard of his natural ability, and of his years of training along one line, and put him to work at something for which he usually is mentally and physically unfit. To be sure, the man is being punished, but that is only one object the State has in view. The State is endeavoring, as I see it, to punish the man, and at the same time to make him work out his debt to the State. In nine cases out of ten you have a round peg in a square hole, with inevitable waste material.

It is self-evident that there is a double economic loss. First, there is the man who has chosen this work. He is skilled in it, and is, under proper conditions, content. He has raised and held himself above the realm of crime, and he is deprived and supplanted by the convict. The convict, unfitted physically and mentally for this work, can contribute but a small percentage of his possibilities toward his indebtedness. He serves his time and in the end comes out an indifferent workman, surly because of uncongenial surroundings and failure, out of touch with his craft or profession. Had he been kept at the thing for which he was fitted, a new interest in his work in life would probably have resulted, and perhaps a useful citizen developed. Can we not find a way to throw the energy and initiative that he has employed in his crime into the right channel?

There is only one way, and that is to develop the man by congenial work, the great panacea for humanity. If charity is to be extended to those in error, put them into labor for which they are best fitted, and let them use their best efforts to support and help those who are dependent on them and who may be in poverty and sinking into further degradation. There is no doubt a man's value to himself and to his country is greatly depreciated when he is legally declared a convict. You may ask who would employ him or patronize him after he has been convicted. There is much in that, but have you helped him by giving him years of enforced apprenticeship in an unfamiliar and uncongenial calling, under demoralizing and degrading conditions?

Already, profit is likely to be realized by some persons, and there is no doubt in my mind, that the men who have profited most will gradually encroach with their chain-gang on other fields of endeavor, and the outcome is unlimited in its complications.

Let penal servitude remain the last resort; but it must be meted out with a little mercy to the guilty.

San Francisco, May 23. J. E. Brown.

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Timber Framing—Part I

By HENRY D. DEWELL*

[Editor's Note: This is the first of a series of five articles by Mr. Dewell.]

Introduction

While timber as a structural material has been largely supplanted by steel and concrete, especially in permanent work, there are still many occasions where it may be employed advantageously in bridges and buildings, and other structures of a somewhat permanent nature. A knowledge of the properties of timber, its capabilities, and its limitations for use in construction, is therefore an essential part of the education of a civil engineer.

The old-school bridge engineer was a past master in the art of timber framing. Many of his structures, it is true, were framed more by experience and judgment than by considerations of theory and of computed stresses, yet the number of timber railroad bridges still giving service testifies to the soundness of his design. The results of his experience have been handed down to his successors and are represented today in the accepted standards of the railway engineer's office. Outside of this class of engineers, however, it may be truthfully said that neither is the art of timber framing generally understood, nor is the value of such knowledge appreciated.

For the design of wooden buildings of exceptional size or of unusual proportions, a structural engineer is now generally retained; otherwise, the plans for framing are prepared in the architect's office. In the latter event the work is usually given to an architectural draftsman possessing little experience in actual construction, and only a superficial and therefore frequently dangerous knowledge of structural mechanics. This practice results from the commonly accepted ideas that timber designing consists in computing the sizes of beams and girders, or in solving the stresses in a roof truss, and that, given the required sizes of the principal structural members of a frame, the carpenter is fully capable of designing the joints. This conception of the scope of timber designing is erroneous. There is no timber structure of an appreciable size which will not justify a careful and intelligent study of the framing details, not alone on the ground of safety, but also from the consideration of economy. Important details should not be left to the judgment of the contractor or carpenter. With all respect for the ability of the experienced carpenter, there is at times nothing so impractical as a so-called 'practical man.' I have seen instance after instance where it would seem that the carpenter had gone out of his way to frame a joint in the weakest possible manner.

Obviously, the method of finding the stresses in a structure is the same whether the material be timber or steel or concrete, and timber joints are as susceptible to analysis for strength as are details in any other material. The cause of the weak details so often seen in timber trusses has been largely the failure on the part of the designer to realize that the joints needed attention. As a test for the display of ingenuity and as a problem to develop one's knowledge of practical and efficient construction, the design of an ordinary mill building in timber and the superintendence of its framing and erection has few equals.

For an intelligent design in timber, a knowledge of sawmill and timber-yard methods is essential. The difficulties of actual framing and erection must also be anticipated and provided for; the designer must imagine himself in the carpenter's place and realize, for example, what cuts will be most difficult to make and what holes will be hard to bore; in other words he must foresee in what details careless work is most likely to occur. The possibility of the timber being green and the consequent shrinkage must be recognized, and if such shrinkage is detrimental to the strength of the structure, means must be provided for tightening the joints after the shrinkage has taken place. As possible incipient causes of failure by shear, the checks due to seasoning must not be neglected. In short, all the limitations of the material must be fully realized.

In the case of structures of steel, the majority of the details can be made in accordance with the standards of present-day practice, fully treated in the text-books and the handbooks of the steel companies and bridge shops. In the realm of reinforced concrete design, certain standards for detailing are being formed rapidly. For timber, however, there are no such standards, except those for bridge and trestle-work generally followed by the railroad engineer. Or, it may be said that in timber construction, many details called standard can be justified by no consideration of efficiency. Even the standards used by the old-school bridge engineers cannot be employed indiscriminately. Certain of these, while entirely suitable for the woods obtainable in the Eastern States, have been transferred to the West and applied without modification to timbers with entirely different properties from those for which the details were designed. The most notable example of this practice is the use of the standard cast or malleable-iron washer with wood as soft as Douglas fir.

For both steel and concrete design and construction there are many good text-books and standard specifica-

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tions, but for timber framing, such as heavy building and bridgework there are only a few text-books and, to my knowledge, no standard specifications. Among the few books dealing with this subject, Jacoby's 'Elements of Heavy Framing' and Howe's 'Simple Roof Trusses' are notable for their excellence, and their contents should be mastered by anyone interested in the design of timber structures; and it is with the view of supplementing these and other existing works rather than writing a text-book that the present articles were undertaken.

A general knowledge of structural design on the part of the reader has been assumed and no attempt has been made to cover the whole field of timber framing, but by discussing the advantages and disadvantages of different typical details, I have tried to point out the structural limitations of the material and the difficulties which arise during construction. Only by a thorough understanding of the many elements that enter into the design of joints and details in timber framing is it possible to make the finished structure safe, efficient, and economical.

A set of general specifications will be given with the concluding article of the series. These specifications are intended primarily for buildings, but with certain obvious modifications are applicable to any timber structure. Since the greatest forests occur in the West, these specifications apply particularly to Douglas fir, but with different unit stresses they may be used for any other timber. The properties of Douglas fir are not far different from those of long leaf yellow pine, so that the specifications may be used with but slight changes for structures built of the latter timber. With these specifications, I hope to establish to some extent certain workable standards for timber framing in general, and for building construction in particular.

The strength of individual sticks of timber varies greatly. For this reason the statement is sometimes made that refinement in calculation of timber framing, and even the computation of stresses, is unnecessary. However, the variation in strength of timbers classed under any one grade is not so great but that definite working stresses can be established with the certainty of such stresses being safe.

It is of the utmost importance then that the designer should be familiar with the probable qualities of the timber of which his structure will be built. He must know the allowable variation in size due to sawing, sizing, and surfacing, also the allowable number and size of the knots and other defects. For this reason, there follow extracts from the 'Standard Classification, Grading, and Dressing Rules for Douglas Fir, Spruce, Cedar, and Western Hemlock Products' as adopted by the West Coast Lumber Manufacturers Association. These specifications while local to the Pacific Coast are typical of the grading rules for any timber.

General Grading Rules

1. All lumber is graded with special reference to its suitability for the use intended.

2. With this in view each piece is considered and its grade determined by its general character, including the sum of all its defects.

3. What is known as "Yard Lumber," such as dimension common boards, finish, etc., is graded from the face side, which is the best side, except that lumber which is dressed one side only is graded from the dressed side.

5. The defects in lumber are to be considered in connection with the size of the piece, and for this reason wider and longer pieces will carry more defects than smaller pieces in the same grade.

6. No arbitrary rules for the inspection of lumber can be maintained with satisfaction. The variations from any given rule are numerous and suggested by practical common-sense, so nothing more definite than the general features of different grades should be attempted by rules of inspection.

7. Lumber must be accepted on grade in the form in which it was shipped. Any subsequent change in manufacture or mill-work will prohibit an inspection for the adjustment of claims, except with the consent of all parties interested.

8. A shipment of any grade must consist of a fair average of that grade, and cannot be made up of an unfair proportion of the better or poorer pieces that would pass at that grade. A shipment of mixed widths shall contain a fair assortment of each width. A shipment of mixed lengths shall contain a fair assortment of each length.

9. Material not conforming to standard sizes shall be governed by special contract.

11. The grade of all regular stock shall be determined by the number, character, and position of the defects visible in any piece. The enumerated defects herein described admissible in any grade are intended to be descriptive of the coarsest piece such grades may contain, but the average quality of the grade should be midway between the highest and lowest pieces allowed in the grade.

12. All dressed lumber shall be measured and sold at the full size of rough material used in its manufacture.

13. All lumber one inch or less in thickness shall be counted as one inch thick.

14. In determining the seriousness of the pitch pocket as a defect both its width and length must be considered. The tighter the pocket the longer it may be.

15. Size and number of pockets admissible in any piece must be left largely to the judgment of the grader and a reasonable deviation from the number of pockets specified in the rules will be permissible.

16. Pitch shakes are clearly defined openings between the grain of the wood, are either filled with granulated pitch or not, but are in either case a serious defect, and must not be admitted in any grade above No. 2 common.

17. A pitch streak is a well defined accumulation of pitch at one point in the piece and when not sufficient to develop a well-defined streak, or where fibre between

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grains is not saturated with pitch, it shall not be considered a defect.

18. A small pitch streak shall be equivalent to not over one-twelfth the width and one-sixth the length of the piece wherein it is found.

19. A standard pitch streak shall be equivalent to not over one-sixth the width and one-third the length of the piece it is in.

20. Splits and checks shall be considered as to length and directions.

21. Wane is bark or lack of wood on edges of lumber from any cause.

22. Chipped-grain consists in part of the surface being chipped or broken out in small particles below the line of the cut, and as usually found should not be classed as torn-grain and shall be considered a defect only when it unfits the piece for the use intended.

23. Torn-grain consists in a part of the wood being torn out in dressing. It occurs around knots and curly places and is of four distinct characters, slight, medium, heavy, deep.

24. Slight torn-grain should not exceed $\frac{1}{32}$ in. deep, medium, 1/12 in., and heavy $\frac{1}{8}$ in. Any torn-grain more than $\frac{1}{8}$ in. shall be termed deep.

25. Loosened grain consists of a point of one grain being torn loose from the next grain. It occurs on the heart side of the piece and is a serious defect, especially in flooring.

26. In standard manufacture of factory flooring, decking, or thick-dressed and matched stock and stock grooved for splines, and for shiplap, the finished width shall be $\frac{1}{2}$ in. less over all than the count or measured width of the rough material used in manufacturing and the tongue and lap shall be measured to determine the finished width.

27. Equivalent means equal, and in construing and applying these rules, the defects allowed, whether specified or not, are understood to be equivalent in damaging effect to those mentioned applying to stock under consideration.

Defects

28. Recognized defects are knots, knot-holes, splits, checks, wane, rot, rotten streaks, pin and grub-worm holes, dog and picaroon holes, pitch seams or shakes, pitch pockets, chipped, torn and loose-grain, solid, pitch, stained heart, sap-stain and imperfect manufacture.

Knots

29. Knots shall be classified as pin, small, standard and large as to size; round and spike as to form; and tight, loose, and rotten as to quality.

30. A pin knot is tight and not over $\frac{1}{2}$ in. diam.

31. A small knot is tight and not over $\frac{3}{4}$ in. diameter.

32. A standard knot is tight and not over $1\frac{1}{4}$ in. diameter.

33. A large knot is tight and any size over $1\frac{1}{2}$ in. diameter.

34. A round knot is oval or circular in size.

35. A spike knot is one sawn in a lengthwise direction.

36. A tight knot or sound knot is one solid across its face, is as hard as the wood itself, and is so fixed by growth or position that it will retain its place in the piece.

37. A loose knot is one not held firmly in place by growth or position.

38. A rotten knot is one not as hard as the wood itself.

39. The mean or average diameter of knots shall be considered in applying or construing the rules.

Pitch

40. Pitch pockets are openings between the grain of the wood, containing more or less pitch and surrounded by sound grain wood.

Sap

41. Bright sap shall not be considered a defect in any of the grades, except as specially provided for in the following rules.

42. Sap-stain shall not be considered a defect except as herein provided.

43. Discoloration of heart-wood or stained heart must not be confounded with rot or rotten streaks. The presence of rot is indicated by a decided softness of the wood where it is discolored, or by small white spots resembling pin-worm holes.

Standard Sizes

46. In the absence of a special agreement between the buyer and seller for each order, all dressed lumber is finished to the following sizes.

47. Flooring: 1 by 3 in., finished size $\frac{13}{16}$ by $2\frac{1}{2}$-in. face; 1 by 4 in., finished size $\frac{13}{16}$ by $3\frac{1}{4}$-in. face; 1 by 6 in., finished size $\frac{13}{16}$ by $5\frac{1}{8}$-in. face; $1\frac{1}{4}$ by 3 in., finished size $1\frac{1}{16}$ by $2\frac{1}{4}$-in. face; $1\frac{1}{4}$ by 4 in., finished size $1\frac{1}{16}$ by $3\frac{1}{4}$-in. face; $1\frac{1}{4}$ by 6 in., finished size $1\frac{1}{16}$ by $5\frac{1}{8}$-in. face; 1 by 6 in. flat-grain flooring, finished size $\frac{3}{4}$ by $5\frac{1}{8}$ in. Standard lengths are multiples of one foot.

53. Widths if dressed on one or both edges: 4 in. to $3\frac{1}{2}$ in.; 5 in. to $4\frac{1}{2}$ in.; 6 in. to $5\frac{1}{2}$ in.; 8 in. to $7\frac{1}{4}$ in.; 10 in. to $9\frac{1}{4}$ in.; 12 in. to $11\frac{1}{4}$ in.; 14 in. to 13 in.; 16 in. to 15 in. Standard lengths are multiples of one foot.

59. Common boards, S1S, or shiplap to $\frac{3}{4}$ inch.

60. Grooved roofing, $\frac{3}{4}$ by $7\frac{1}{4}$ in., $9\frac{1}{4}$ or $11\frac{1}{4}$ in. face; $\frac{1}{2}$-in. groove, $1\frac{1}{2}$ in. from each edge.

61. Shiplap and Dressed and Matched: 1 by 8 in., finished size $\frac{3}{4}$ by 7-in. face; 1 by 10 in., finished size $\frac{3}{4}$ by 9-in. face; 1 by 12 in., finished size $\frac{3}{4}$ by 11.in. face. Standard lengths are multiples of two feet.

62. Dimension, S1S1E, or S4S: 2 by 4 in. to $1\frac{5}{8}$ by $3\frac{5}{8}$ in.; 2 by 6 in. to $1\frac{5}{8}$ by $5\frac{5}{8}$ in.; 2 by 8 in. to $1\frac{5}{8}$ by $7\frac{1}{2}$ in.; 2 by 10 in. to $1\frac{5}{8}$ by $9\frac{1}{2}$ in.; 2 by 12 in. to $1\frac{5}{8}$ by $11\frac{1}{2}$ in.; 3 by 6 in. to $2\frac{1}{2}$ by $5\frac{1}{2}$ in.; 3 by 8 in. to $2\frac{1}{2}$ by $7\frac{1}{2}$ in.; 3 by 10 in. to $2\frac{1}{2}$ by $9\frac{1}{2}$ in.; 3 by 12 in. to $2\frac{1}{2}$ by $11\frac{1}{2}$ inches.

63. Timbers, S1S1E, or S4S, 4 by 4 in. and larger,

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½ in. off each way. Standard lengths are multiples of two feet unless otherwise specified.

64. All sizes in dimensions and timbers are subject to natural shrinkage.

Fir Common

Boards and Shiplap and Dressed and Matched.

117. One-inch select common, 4 to 12 in.; shall be square edged; will admit sound knots not over 1 in. diameter in 4 in. and 6 in. and not over 1½ in. in 8 in. to 12 in., but situated away from edge; medium-sized pitch pockets and slight stain, but should be of a sound strong character. Hemlock permitted in this grade.

118. Common: Will admit of any two of the following, or their equivalent of combined defects: Wane ½ in. deep on edge, 1 in. wide on face, extending not over one-sixth of the length of the piece; knots not more in diameter than one-third of the width of the piece; stain; torn grain; pitch streaks; pitch pockets; seasoning checks; one straight split not longer than the width of one piece or a limited number of worm-holes well scattered. These boards should be firm and sound and suitable for use in ordinary construction without waste. Hemlock permitted in this grade.

119. No. 3 common boards or sheathing: Will admit of all stock below the grade of common that is suitable for cheap sheathing and will allow: Coarse knots, knot-holes, splits, rotten sap, and any number of grub or pin-worm holes. Hemlock permitted in this grade.

Dimension

121. Common dimension: Generally speaking, this stock must be suitable and of sufficient strength for all ordinary construction purposes without waste. Will admit of coarser knots than 1-in. common, which in a 2 by 4-in. should not be larger than 2 in. Spike knots not over two-thirds the width of the piece; wane not over ½ in. deep on edges and 1 in. wide on face up to 2 by 6 in., and ½ in. deep on edge and 1½ in. wide on face on 2 by 8 and wider, extending not more than ¼ the length of the piece; stain; solid pitch; pitch pockets; seasoning checks; one straight split, not more than the width of the piece, 2 or 3 grub-worm holes, a limited number of pin-worm holes and torn grain. Hemlock permitted in this grade in 4 and 6-in. widths.

122. No. 2 common dimension: This grade must be suitable for use in a cheaper class of construction than common. Will allow coarse and unsound knots and knot holes that do not unfit the piece for use intended, rotten streaks, pitch seams, pitch pockets, a reasonable amount of rotten sap and pin-worm holes, a few grub-worm holes well scattered. It is understood that no culls or stock that will not work without waste will be allowed in this grade. Hemlock permitted in this grade in 4 and 6-in. widths.

Fir timbers

123. Selected common: 2 by 4 in. to 2 by 12 in. and 3 by 4 in. to 4 by 6 in. shall be square-edged. Will admit any quantity of sound knots not over 1 in. diam., or small pitch pockets not over 4 in. in length. Sizes larger than 4 by 6 in. will admit sound knots not to exceed 1½ in. diameter; pitch pockets not to exceed 6 in. in length.

124. Common: Rough timbers, 4 by 4 in. and larger, shall not be more than ¼ in. scant when green, or ½ in. scant when S1S1E or S4S, and be evenly manufactured from sound stock and must be free from knots that will materially weaken the piece.

125. Timbers 10 by 10 in. may have a 2 in. wane on one corner, or its equivalent on two or more corners, one-fourth the length of the piece. Other sizes may have proportionate defects. Season checks and checks extending not over one-eighth the length of the piece admissible.

126. No. 2 common timbers: This is a grade of timber that will admit of large, loose, or rotten knots, shakes, or rot that do not impair its utility for temporary work. Hemlock and white fir will be allowed in this grade.

Fir Car Material

149. Railroad ties: Shall be sound common lumber.

Fir Bridge-Stringers

150. Common: Shall be sound common lumber, free from large unsound knots or knots in clusters, or other defects that will materially unfit the piece for the purpose intended.

151. Select common: Sap shall not show on any one corner more than 10% of any side or edge measured across the surface anywhere along the length of the piece. Shall be free from shake, splits, or pitch pockets over ⅜ in. wide or 5 in. long. Knots greater than 2 in. diam. will not be permitted within one-fourth of the depth of the stringer from any corner nor upon the edge of the piece; knots shall in no case exceed 3 in. diameter.

Western Hemlock

214. Western hemlock is a wood well adapted to many uses. It is strong, holds nails well and therefore makes good framing lumber. It is hard and wears well as flooring. It is easily dressed to a smooth surface, and takes a fine polish, which, together with the beauty of grain and color, makes a fine interior finish. Western hemlock is entirely free from the 'wind shake' so common in the hemlock of the East. This lumber has been sold in the East under various names, such as 'Alaska pine,' 'Columbia pine,' 'gray fir,' 'Washington pine,' etc., and has given good satisfaction.

215. In a general way the rules for grading fir and spruce are applied to hemlock.

The preceding specifications apply to lumber as shipped in carload lots to the various retailers. When lumber is purchased from the retail lumber yard, it is usually classified as 'No. 1 common' or 'merchantable.' The specifications governing this grade are much less strict in classification, and may be found in the 'Domestic List No. 6, of the Pacific Lumber Inspection Bureau.' The quality of the material purchased under these con-

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ditions, it is hardly necessary to state, depends largely on the standards of the local yard, and in the average case, such lumber will undoubtedly contain a considerable proportion of No. 2 common.

Unit Working Stresses

The allowable unit stresses to be used in any material are always a matter of individual judgment in the end. They should be decided from considerations of probable quality of material, nature of the loading, that is, whether live or dead, and if live, whether accompanied by impact, whether a constant load or one occurring at rare intervals; the particular detail under consideration, the purpose which the structure is to serve, the probabilities of future increase in loading or modifications of use, of the structure, and the character of the superintendence. Theoretically, the last condition may not influence the design, since the engineer is not necessarily responsible for the field inspection and must many times in his design assume competent and conscientious superintendence. Practically, however, no reputable engineer would use high working stresses did he know that the field inspection would be of questionable amount and quality.

For steel and concrete, the working stresses have been quite definitely established both by tests and experience. Of all structural materials, steel is the most uniform in quality, skilled labor being employed at all stages of its manufacture, fabrication and erection. In the case of concrete, the quality and strength of the finished product can be determined in general by selecting and proportioning the ingredients and by careful workmanship. Hence for different proportions of material, working stresses are now quite definitely established. On the other hand, sawed lumber is a finished product, and its strength must be judged by its physical appearance alone. The diversity of opinion as to the proper unit stresses or design may be demonstrated by even a cursory examination of the building codes of the different cites of the United States. This lack of similarity is especially striking in the case of the specified working stresses for timber in bending, these stresses varying by 150%.

However, in comparing the different unit working stresses adopted by the various building codes, it must be remembered that the specified loadings also vary, and to make a true comparison all stresses must be reduced to the same load-base. The working unit stresses given in building ordinances are generally rather low, in accordance with the average low grade of timber used.

Kind of Timber	Bending: Extreme Fiber Stress: Average Ultimate	Bending: Extreme Fiber Stress: Working Stress	Bending: Modulus of Elasticity: Average	Shearing: Parallel to Grain: Average Ultimate	Shearing: Parallel to Grain: Working Stress	Shearing: Long Shear in Beams: Average Ultimate	Shearing: Long Shear in Beams: Working Stress	Compression: Perpendicular to Grain: Elastic Limit	Compression: Perpendicular to Grain: Working Stress	Compression: Parallel to Grain: Average Ultimate	Compression: Parallel to Grain: Working Stress	Compression: For Columns: Ultimate Working Stress	Compression: Formula for Working Stress in Long Columns over 15 d	Ratio of Length of Struts to Width
Douglas Fir	6100	1200	1 510 000	690	170	270	110	630	310	3600	1200	900	1200(1-l/60d)	10
Longleaf Pine	6500	1300	1 610 000	720	180	300	120	520	260	3800	1300	980	1300(1-l/60d)	10
Shortleaf Pine	5600	1100	1 480 000	710	170	300	130	340	170	3400	1100	830	1100(1-l/60d)	10
White Pine	4400	900	1 130 000	400	100	183	70	290	150	3000	1000	750	1000(1-l/60d)	10*
Spruce	4800	1000	1 310 000	600	150	170*	70	370	180	3200	1100	830	1100(1-l/60d)	
Norway Pine	4200	800	1 190 000	390*	130	250	100		150	2600*	800	600	800(1-l/60d)	
Tamarack	4800	900	1 220 000	670	170	261	100		220	3200*	1000	750*	1000(1-l/60d)	
West Hemlock	5800	1100	1 480 000	630	160	270*	100	440	220	3500	1200	900	1200(1-l/60d)	
Redwood	5000	900	800 000	300	80			400	150	3500	900	680	900(1-l/60d)	
Bald Cypress	4800	900	1 150 000	500	120			340	170	3900	1100	830	1100(1-l/60d)	
Red Cedar	4200	800	860 000	...	...	...		470	230	2800	900	680	900(1-l/60d)	
White Oak	5700	1100	1 150 000	840	210	270	110	980	450	3500	1300	980	1300(1-l/60d)	12

PLATE I—UNIT STRESSES IN STRUCTURAL TIMBER IN POUNDS PER SQUARE INCH.

Adopted by the American Railway Engineering and Maintenance of Way Association upon recommendation of the Committee on Wooden Bridges and Trestles.

*Partly air-dried.

l = length in inches.

d = least side in inches.

The stresses are for a green condition of timber and are to be used without increasing live-load stresses for impact.

The working stresses given in this table are intended for railroad bridges and trestles. For highway bridges and trestles, the unit stresses may be increased 25%. For buildings and similar structures in which the timber is protected from the weather, and practically free from impact, the unit stresses may be increased 50%. To compute the deflection of a beam under long-continued loading instead of that when the load is first applied, only 50% of the corresponding modulus of elasticity given in the table is to be employed.

Probably the best guide in selecting stresses for timber, is the Report of the Committee on Wooden Bridges and Trestles of the American Railway Engineering and Maintenance of Way Association. Plate I gives a summary of their recommendations. H. S. Jacoby, himself a member of this committee, says: "These unit stresses are the result of an extended study of all the full-sized tests of structural timber available, as well as the unit stresses which have been in use in designing wooden bridges and trestles and have been demonstrated to be safe by extensive experience. As indicated in the footnote (see Plate I), the values are based on a green condition of the timber, but in a few cases where no data for green timber were available, those for partly air-dry timber were inserted.* * * The table contains no working unit stresses for pure tension. Wood has a greater resistance to tension than to any other kind of stress, and it is found to be difficult to break it in a true tensile test. As there is more or less cross-grain, it is advisable to use the same unit stress in designing tensile members as for bending."

The working stresses as given by this table (increased 50% for buildings) are the highest that should be used for any structural timber. In fact they would seem to be too high for the material commonly used for ordinary building construction. The specifications given for determining the quality of timber for which these stresses are recommended are much more strict than those of the lumber manufacturers.

In 'Properties and Uses of Douglas Fir,'† there is

†Forest Service Bulletin No. 88, U. S. Department of Agriculture, p. 43-45.

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given the result of bending-tests on 175 green bridge-stringers, purchased in the open market, 8 by 16-in. cross-section, and graded according to various standard specifications. It is interesting to note that only 54 of these stringers fell within the No. 1 railroad grade of the Specifications of the American Railway Engineering and Maintenance of Way Association. Table 10 of this bulletin shows the modulus of rupture of the high 10%, embracing five tests, to be 8648 lb. per square inch; that of the low 10%, embracing five tests, 5750 lb. per square inch. The average modulus of rupture of all of these tests was 7108 lb. per square inch. The corresponding stresses at the elastic limit were 5800 lb., 3374 lb., and 4516 lb. per square inch.

When graded according to the specifications for No. 2 railroad, 67 stringers came within the limit. The high 10%, comprising eight stringers, had a modulus of rupture of 7430 lb. per square inch and a fibre stress at the elastic limit of 5006 lb. per square inch. Eight stringers also constituted the low 10%, having fibre stresses of 4761 lb. and 3109 lb. per square inch at the ultimate strength and elastic limits, while the general average fibre stresses were 6116 lb. and 4057 lb. per square inch.

In a similar manner the stringers were graded according to the export grading rules of the Pacific Coast Lumber Manufacturer's Association, adopted 1903. In the essentials, these are the same as the present specifications of the West Coast Lumber Manufacturer's Association. Thirty stringers fell within the grade of 'merchantable.' The high 10% had a modulus of rupture of 6353 lb., the low 10% 3710 lb., while the average modulus was 4946 lb. per square inch. The stresses at the elastic limits were 4597 lb., 2580 lb., and 3532 lb. per square inch, respectively.

Taking the safe working fibre stress in bending for timbers of the grade of Railroad No. 1 as 1800 lb. per square inch, it is interesting to compute the corresponding fibre stresses for timber of the grade of 'merchantable' by the Pacific Coast export grading rules. On the basis of the average ultimate strength this fibre stress would be $\frac{4946}{7108} \times 1800$ or 1250 lb. per square inch. On the basis of the elastic limit the stress would be $\frac{3532}{4516} \times 1800$ or 1410 lb. per square inch.

Similarly, assuming that a working stress of 1800 lb. per square inch is satisfactory for timber of the grade of Railroad No. 2, the corresponding stresses for merchantable timber would be $\frac{4946}{6116} \times 1800$ or 1450 lb. per square inch, based on the respective moduli of rupture, and $\frac{3532}{4057} \times 1800$ or 1560 lb., per square inch, based on the respective elastic limits.

On the basis of the above comparison it is believed that 1500 lb. per square inch is the highest working unit-stress that should in general be allowed for ordinary building construction with good inspection. Where the inspection is likely to be either poor or else wholly lacking, it would seem that the value of 1200 lb. per square inch should not be exceeded for timber in bending.

This statement is made for the following reasons: first, generally poor grade of timber as furnished by the local lumber-yard; second, undersize of timbers, especially of joists, due to surfacing or resawing, since any material over $1\frac{1}{2}$ in. thick sells as 2-in. stock; and, third, holes bored, or notches cut in joists to accommodate conduits and pipes, these holes or notches often being placed in the worst possible position as regards the strength of the joist.

It will be noted that the table of unit stresses of the American Railway Engineering and Maintenance of Way Association gives no value for the elastic limit of timber in bending. While it is true that timber has not the definite elastic limit of steel, yet there is a definite yield point and no working stresses should be determined without a consideration of this property. The elastic limit is especially important in the case of bearing perpendicular to the fibres of the timber, and the allowable stress for cross-bearing should be based on this limiting resistance and not on the ultimate strength. The folly of small washers of insufficient size, for rods or bolts taking tension, has been mentioned before and will be treated more fully in a succeeding article. There are reproduced here (Plates II and III) two diagrams taken from Forestry Bulletin No. 88, showing the variation in the ultimate stresses and the stresses at the elastic limit of the Douglas fir bridge-stringers tested.

Probably the most troublesome part of detailing connections in timber is to make the necessary provision that the cross-bearing strength be not exceeded. Indeed, it will usually be found upon examination of typical structures that this point has not been considered. I have found that a great many designers consider that the crushing of the fibres of the timber in side-bearing is not a serious matter. The idea is prevalent that, after an initial crushing, no further deformation will take place, and that the structure will still be in a working condition. The fallacy of this idea will be realized by anyone who has seen an actual test made on the crushing strength of timber across the fibres. In designing timber framed structures, this weakness of timber must be carefully considered, otherwise, the consequent deformation may unduly stress other parts. Plate II shows that the average elastic limit is about 570 lb. per square inch, therefore the working stress may be taken at 285 lb. per square inch.

Reference to Plate II shows that the average elastic limit of Douglas fir for end compression or pressure against the ends of the fibres is 3612 lb. per square inch. The working stress as recommended by Plate I for buildings is 1800 lb. per square inch, which gives a safety factor of two on the basis of the elastic limit. I prefer in general to limit the pressure to 1600 lb. per square inch. When providing for the stresses of compression, tension, and shear, the nature of the detail should always receive consideration in deciding the exact amount of working stress. Under some conditions 1800 lb. per

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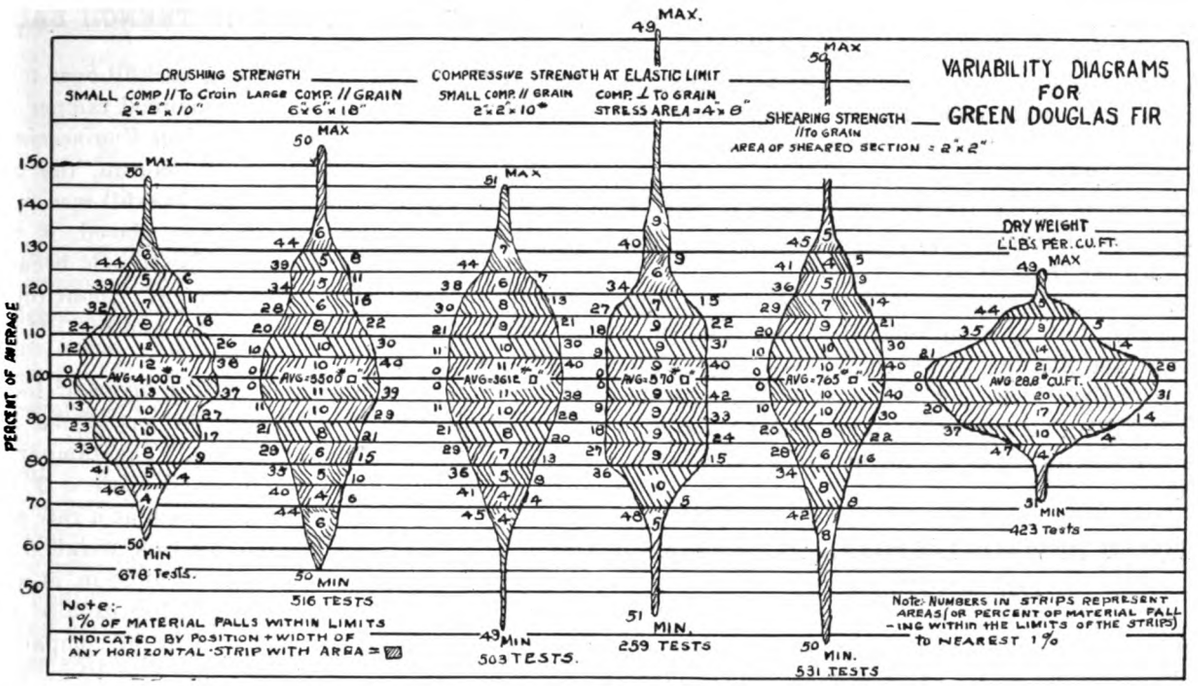

PLATE II—ILLUSTRATING VARIABILITY OF GREEN DOUGLAS FIR IN CRUSHING STRENGTH, COMPRESSIVE STRENGTH AT ELASTIC LIMIT, SHEARING STRENGTH, AND DRY WEIGHT.

square inch and even slightly more will provide a sufficient factor of safety. For example, the basic‡ working compressive unit-pressure of a lag screw in timber may be well taken at 1800 lb. per square inch, since there is a close and uniform fit of the lag screw in the bored hole. On the other hand, the actual pressure of the toe of the batter-post of a truss against the shoe-plate may be almost as great as the ultimate strength of timber in end compression, depending altogether upon how accurately the carpenter shapes the batter-post to fit the shoe. It is evident, then, that in details involving difficult cuts, a relatively low unit pressure should be used, and in straight cross-cuts a corresponding higher working stress may be justly employed.

This intentional variation in unit stress applies with greater force to the consideration of details involving

‡Basic, as distinguished from average unit stress on diametral section of lag-screw, to be discussed in next article.

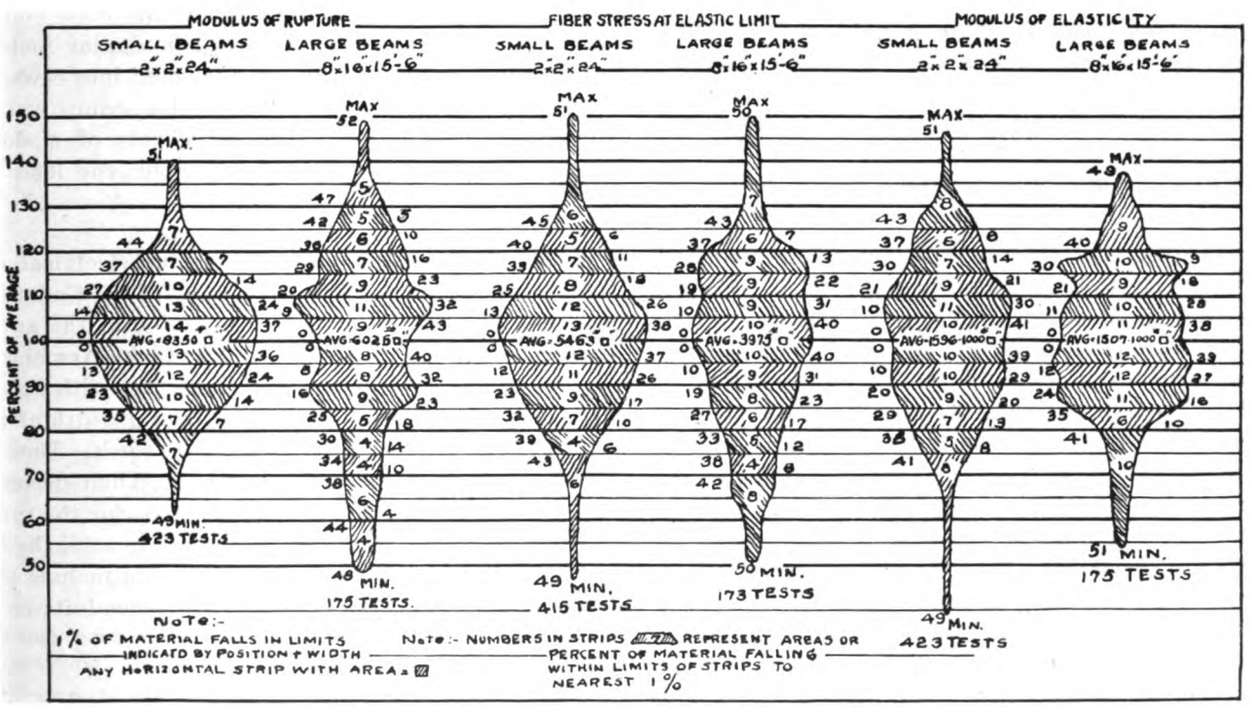

PLATE III—ILLUSTRATING VARIABILITY OF GREEN DOUGLAS FIR IN MODULUS OF ELASTICITY, MODULUS OF RUPTURE, AND FIBER STRESS AT ELASTIC LIMIT.

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the stress tension. Timber has a high tensile resistance, and where it is certain that no other stress exists than simple, uniformly distributed tension, the working stress of 1800 lb. per square inch or even higher is not excessive. However, as will be shown later, secondary stresses of indeterminate but nevertheless large amount may exist, as in the case of tension chords in trusses. For this reason I prefer 1500 lb. per square inch as a general limit for Douglas fir in tension.

The ever-present season-crack in timber as an incipient cause of failure by shear along the fibres is sufficient justification for limiting the working stress in shear to 150 lb. per square inch, and it is wise to decrease this stress to 100 lb. per square inch, unless it is necessary to exercise the strictest economy in the design of the particular detail.

PROPOSED SEWAGE-DISPOSAL PLANTS AT LOS ANGELES

Preliminary plans have been completed by city engineer Homer Hamlin for a system that is to treat the entire sewage of the city of Los Angeles. The principal plant is to be at the present main outfall at Hyperion. Imhoff tanks and sludge-beds able to take care of 63,000,000 gallons of sewage per day will be constructed. It is estimated that this will provide for a future population of 1,000,000. The present maximum flow is 42,000,000 gallons per day. The effluent is to be discharged under the ocean surface from a new outfall pier at from 1200 to 2000 ft. from shore. The plans also call for an additional outfall sewer. Smaller disposal plants of a similar type are to be constructed at San Pedro, East San Pedro, and Wilmington. They will provide for an ultimate population of 46,900. As a part of the general sewage-disposal plan a pumping-plant at Manchester avenue is proposed. The total cost of the proposed system is estimated at $1,800,000. A bond issue for that amount is to be submitted to the voters on June 6.

EFFECT OF EXCESS WATER IN CONCRETE

Thirty 6 by 12-in. concrete cylinders were prepared and tested at the recent Cement Show in Chicago. These were made of a 1:2:4 mixture, the proportions by weight being cement, 4.7 lb.; sand, 10.8 lb.; and gravel, 20.7 lb. For 15 of the cylinders, 6.75% by weight of the dry materials of water was used. For the other 15, 9% water was used. At the end of 28 to 31 days the cylinders were tested. The greatest strength shown by any of the specimens mixed with 6.75% of water was 97,000 lb., the least was 70,000 lb., and the average was 79,000 lb. The greatest strength shown by any of the specimens mixed with 9% of water was 72,000 lb., the least was 35,000 lb., and the average was 52,680 lb. Besides the greater strength of the dry concrete specimens, their smaller variation in strength as compared with the wet concrete specimens is noticeable.

MECHANICAL TAMPING OF TRENCH BACKFILL

Methods and costs of tamping backfill over telephone conduits by hand and by a mechanical tamper are discussed by C. W. Wilson in *Municipal Engineering*. The work was done at Superior, Wisconsin, the material being a tough red clay. As the backfill was made immediately after the concrete was placed, it was impossible to use water to puddle the trench, because this would have washed away the cement. About four miles of trench was back-filled by hand and 6000 ft. by machine.

Where the machine was used a layer of loose dirt about 8 in. deep was shoveled on top of the concrete before it received its initial set. The tamper, which was a traction machine equipped with a 3 hp. gas engine, was then run over the trench at a rate of about 9 ft. per minute. The tamping ram weighed 150 lb. and was dropped through a height of 26 in. at a rate of 42 blows per minute. This tamping usually reduced the 8-in. layer of loose dirt to 4 in. of compacted material. Another layer of loose dirt 8 to 10 in. was then shoveled into the trench, and the tamper run over it again. The process was repeated until the trench was full. The average cost of tamping by hand was $0.08 per lineal foot of trench and by machine, $0.02. The average depth of trench was 3 ft. and the average width 18 inches.

Weights of crowds per sq. ft. of floor space have been investigated and reported in *Zentralblatt der Bauverwaltung*. A group of 250 men in two lines similar to company formation but with the ranks moved forward into close contact gave a load of 85 lb. per sq. ft. A mixed group of 400 men, women, and children, arranged in four ranks and moved up into close contact gave the same unit-load. Grouped in similar rectangular formation, but without arrangement into rows, the load was 98 lb. per sq. ft. When this group was set in motion, walking forward at the rate of a slowly moving crowd, about 1½ miles per hour, the load was 40 lb. per square foot.

Costs of construction of tunnels for electrical conduits in Chicago are given in a report of the Committee on Underground Construction presented at the annual convention of the National Electric Light Association. These tunnels have an inverted U-section with a vertical height of 6 ft. 6 in. in the clear and a width of 6 ft. The walls are of concrete and are 9 in. thick. They are driven from shafts 6 ft. 6 in. diam. When driven in clay, the cost is from $25 to $30 per foot for the tunnel and $50 to $60 per foot for the shaft. In rock the cost is about 50% higher. These prices do not include manholes at the top of the shafts nor the conduits in the tunnel and shafts.

Peat is being used as fuel in a steam-electric plant at Ostfriesland, Germany. From 5.3 to 6.6 lb. of sun-dried peat is needed per kilowatt-hour.

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Determination of Maximum Stream-Flow*

By C. E. GRUNSKY†

The formula discussed by me in a preceding article‡ for determining the maximum storm-water flow was originally devised for use in connection with urban and suburban areas. Such areas are usually of relatively small extent. The formula is equally applicable to the large watershed. However, no attempt has yet been made to determine what value should be assigned to the coefficient a, which appears in the formula, when the formula is used to estimate the maximum discharge from a large watershed, as in the case of a river.

Before entering upon a discussion of its applicability in determining maximum stream-flow the notation used in the first article and the basic formula may be recalled. The equation numbering will be continued from the earlier article.

Let A = the area of the watershed in acres.

A' = the area of the watershed in square miles.

a = the coefficient of perviousness of the surface of the entire watershed. This coefficient remains the same regardless of whether the square mile or the acre be made the area unit.

a' = a variable depending on the surface characteristics of the watershed.

t = the critical time in minutes during the continuance of a rainstorm of maximum intensity, for the area under consideration, being that time within which the rain will produce maximum discharge.

T = the time in minutes that it will take water under maximum run-off conditions to flow from the most remote part of the watershed to the point at which the maximum stream-flow is to be determined.

v = the watershed run-off velocity—a function of slope, expressed in feet per second.

I = the maximum average rainfall intensity on entire watershed expressed in inches per hour, during any t minutes.

R = the maximum amount of rain, in inches, on entire watershed in any one hour.

C = the rain intensity constant.

q = the maximum stream-flow in cubic feet per second per acre.

q' = the maximum stream-flow in cubic feet per second per square mile.

Q = the maximum stream-flow, or the maximum rate of run-off expressed in cubic feet per second.

Fundamental equations (see the earlier aticle):

$$I = \frac{C}{\sqrt{t}} \tag{1}$$

$$R = \frac{C}{7.75} \tag{2}$$

$$q = \frac{5\,a\,R}{\sqrt{t}} \tag{8}$$

$$q = 0.645\,a\,I \tag{9}$$

When the formula is used to estimate maximum stream-flow it will be found convenient to use the square mile, instead of the acre, as the unit area. In that event square miles may be written in the equations (6) and (7) of the earlier article, and for maximum stream-flow the formulæ (8) and (9) will become:

$$q' = \frac{3200\,a\,R}{\sqrt{t}} \tag{10}$$

$$\text{and } q' = 413\,a\,I \tag{11}$$

$$\text{from which } Q = \frac{3200\,a\,A'R}{\sqrt{t}} \tag{12}$$

$$\text{and } Q = 413\,a\,A'I \tag{13}$$

In applying this formula, or in attempting to establish a value for the variable a, care must be taken to determine properly the rain intensity for the entire watershed. The individual station record is not as dependable for a large watershed as for a small one. Whenever practicable the relation of the rainfall on the entire watershed to that of a single station or better to a combination of stations should be ascertained, by comparing the station records with the average rain on the whole area determined by isohyetose lines.

Even though no dependable information is at hand relating to the value of a which should be used when the formula is applied to large watersheds, there may be some speculation regarding the run-off which the formula indicates under certain assumptions that seem reasonable in the light of available run-off data.

It is evident that due to soil absorption and evaporation losses the value of a must decrease as the time increases during which water is flowing over the surface of the watershed and that for a small impervious area $a = 1$. This suggests the following expression for a:

$$a = \frac{60}{60 + c\sqrt{t}} \tag{14}$$

where c is a coefficient to be determined from the surface conditions of the watershed.

The following values are suggested tentatively and remain subject to correction.

For impervious areas $c = 0.10$.

*Supplement to 'Determination of the Maximum Storm-Water Flow,' published in WESTERN ENGINEERING, Vol. V, p. 254.

†Consulting engineer, Mechanics Institute Bdg., San Francisco.

‡WESTERN ENGINEERING, Vol, V, p. 254.

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For mountainous areas $c = 2$.

For rolling country $c = 3$.

For flat country (ordinary soil) $c = 10$.

For sandy regions $c = 50$.

These values are suggested for application under ordinary conditions in temperate climates. They will no doubt be found too small in localities where the ground may be frozen, where the ground is water-logged or where the maximum run-off occurs when rain falls upon snow.

TABLE

The value of the coefficient a in the formula for maximum stream-flow: $q' = 413\,a\,I$ or $q' = \frac{320\,a\,R}{\sqrt{t}}$ based on $a = \frac{60}{60 + c\sqrt{t}}$

Critical time, t Min.	Impervious areas $c = 0.10$	Mountains $c = 2$	Rolling country $c = 3$	Flat country $c = 10$	Sandy regions $c = 50$
5	1.00	0.93	0.90	0.73	0.35
10	1.00	0.90	0.87	0.66	0.27
20	0.99	0.87	0.82	0.57	0.21
30	0.99	0.85	0.79	0.52	0.18
60	0.99	0.79	0.72	0.44	0.13
120	0.98	0.73	0.65	0.35	0.099
180	0.98	0.69	0.60	0.31	0.082
600	0.96	0.55	0.45	0.20	0.049
1,440	0.94	0.45	0.35	0.14	0.028
7,200	0.88	0.26	0.18	0.066	0.013
14,400	0.83	0.20	0.14	0.048	0.009
28,800	0.78	0.15	0.11	0.034	0.007

Areas of various extent but of similar outline, or similar surface conditions, and of similar topographic features will have values of t proportional to $\sqrt{A'}$. Consequently $t = K\sqrt{A'}$

Here K is a coefficient which can be determined for any set of watersheds complying with the condition of similarity as here stated.

A number of similar mountainous watersheds may now be considered for which a value of $K = 20$ has been ascertained. This will make $t = 20\sqrt{A'}$ and the formula for the maximum run-off rate from such similar areas will be

$$q'' = \frac{3200\,a\,R}{\sqrt{20}\,\sqrt[4]{A'}}$$

$$\text{or } q'' = \frac{715\,a\,R}{\sqrt[4]{A'}}$$

$$\text{and } Q'' = 715\,a\,R\,(A')^{3/4}$$

Here due to the mountainous condition a will be determined by the expression $\frac{60}{60 + 2\sqrt{t}}$ or $\frac{60}{60 + 8.95\,(A')^{1/4}}$

and therefore:

$$q'' = \frac{42{,}900\,R}{60\,(A')^{1/4} + 8.95\,(A')^{1/2}} \text{ for the special case only.}$$

$$\text{and } Q = \frac{42{,}900\,R\,(A')^{3/4}}{60 + 8.95\,(A')^{1/4}} \text{ for the special case only.}$$

The following values result for the special case under consideration and areas ranging from 10 to 10,000 square miles:

Area			$t = 63$ minutes		$q'' = 317\,R$	$Q'' = 3{,}170\,R$
20	"	"	89	"	258 R	5,160 R
50	"	"	142	"	191 R	9,550 R
100	"	"	200	"	153 R	15,300 R
200	"	"	283	"	122 R	24,400 R
300	"	"	346	"	105 R	31,500 R
400	"	"	400	"	96 R	38,400 R
500	"	"	450	"	89 R	44,500 R
1,000	"	"	630	"	69 R	69,000 R
5,000	"	"	1,400	"	38 R	190,000 R
10,000	"	"	2,000	"	29 R	290,000 R

It is apparent from these values that in mountainous regions, all exposed to the same rainfall conditions, the rate of run-off per square mile as determined by the formula is 11 times greater from an area 10 square miles in extent than from an area of 10,000 square miles. In the light of the run-off information obtainable from the records of the U. S. Geological Survey and other sources, this relation appears quite reasonable.

The application of the formula can best be illustrated by recourse to a few examples:

1. What is the maximum discharge of a river draining a mountain watershed 1900 square miles in area, in which the maximum amount of rain on the entire watershed in 24 hours is 8 in. and for which $t = 12$ hours or 720 minutes.

Here

$$a = \frac{60}{60 + 2\sqrt{720}} = 0.52$$

From (1) generalized

$$C = \frac{8}{24}\sqrt{1440} = 12.7$$

From (1)

$$I = \frac{12.7}{\sqrt{720}} = 0.47$$

And from (13)

$$Q = 413 \times 0.52 \times 0.47 \times 1900$$
$$= 192{,}000 \text{ second-feet.}$$

The conditions suggested in this example are comparable with those which prevail in the watershed of the American river, above Folsom, California, which, from a watershed of 1900 square miles, at that point, has probably discharged as much as 180,000 to 200,000 second-feet (1861-62).

2. What is the maximum discharge of a river draining a watershed $\frac{3}{4}$ mountainous and $\frac{1}{4}$ rolling or foothill land, 9000 square miles in area in which the maximum amount of rain in two days over the entire watershed is 6 in. and for which $t = 30$ hours or 1800 minutes.

Here the value of a will lie between the value determined for a mountainous area and that for a rolling country:

$$a = \frac{3}{4}\left(\frac{60}{60 + 2\sqrt{1800}}\right) + \frac{1}{4}\left(\frac{60}{60 + 3\sqrt{1800}}\right)$$
$$a = 0.39$$

From (1) generalized

$$C = \frac{6}{48}\sqrt{2880} = 6.7$$

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From (1)

$$I = \frac{6.7}{\sqrt{1800}} = 0.158$$

And from (13)

$$Q = 413 \times 0.39 \times 0.158 \times 9000$$
$$= 229{,}000 \text{ second-feet.}$$

The conditions suggested in this example are comparable with those which prevail in a watershed of the area of Sacramento river above Red Bluff, California, where the maximum recorded discharge has been about 250,000 second-feet.

3. What is the maximum discharge of a river draining a watershed of 250,000 square miles, equal parts of which are classed as mountain and as rolling country, in which the greatest amount of rain in one month over the entire watershed is 6 in. and for which $t = 20$ days or 28,800 minutes.

Here

$$a = \frac{1}{2}\left(\frac{60}{60 + 2\sqrt{28{,}800}} + \frac{60}{60 + 3\sqrt{28{,}800}}\right)$$
$$a = 0.13$$

From (1) generalized

$$C = \frac{6}{720}\sqrt{43{,}200} = 1.73$$
$$I = \frac{1.73}{\sqrt{28{,}800}} = 0.0102$$
$$Q = 413 \times 0.13 \times 0.0102 \times 250{,}000$$
$$= 137{,}000 \text{ second-feet.}$$

This third illustration is typical of conditions which prevail in the watershed of Colorado river which has a watershed area of about 225,000 square miles from which the runoff has at times reached 0.6 second-feet per square mile.

There is no need of extending illustrations to still larger watersheds because the necessary basic data are not available and because the values for the constants and coefficients here introduced are only suggestive. Enough has been said, however, to show that the type of formula is reasonable and that it will be found particularly useful in estimating from known conditions of the flow from one watershed what the maximum runoff or stream-flow from another will be in which the climatic conditions are similar, and also in estimating the maximum rate of runoff due to a rain of extreme intensity when the maximum rate due to a less intense, but yet heavy rain, has been ascertained by stream gauging. While a formula has been presented for determining the value of t from the value of T, equation (6) of the earlier article, this is intended to serve only for first approximation purposes. Because the value of t varies with the varying outline of the watershed and with its topography, it should be determined by direct estimate, whenever possible, for use in final computations.

When large portions of a watershed are lake or reservoir-surface, special consideration must be given to this fact, because the retention of water in storage basins reduces the maximum rate of outflow therefrom and reduces the discharge of the stream below the storage basin and may therefore have an effect upon the maximum stream-flow that should not be neglected. Recourse may have to be had to the mass curve in order to determine this effect.

CURBS AND SHOULDERS FOR CONCRETE HIGHWAYS

The following recommendations were made to the Conference on Concrete Road Building by the Committee on Curbs and Shoulders, composed of A. N. Johnson, chairman, A. W. Dean, A. B. Fletcher, Charles E. Russell, and Edward M. Laing.

For 'single-track' highways, or those where the concrete does not exceed 10 ft. in width and on grades less than 5%, 4-ft. macadam or gravel shoulders are recommended. The shoulders should not be constructed until the concrete has full opportunity to harden, and when finished, they should, if anything, be slightly above the concrete to facilitate turning back from the shoulder to the concrete.

For 'two-track' highways, or those where the concrete is at least 16 ft. wide, shoulders need not be provided for traffic, but only for occasional 'turnouts.' Shoulders of this class may be constructed of earth material, excluding all vegetable or other material likely to decay. The slope of the shoulder to the gutter should be continuous, and deep open ditches should not be constructed.

For 'single-track' highways on grades of 5% or over, it is recommended that the width of the concrete be increased to 15 or 16 ft. and that curbs be constructed. This will allow the use of the entire road as a gutter during excessive rainfalls. Curbs in cuts should be given an upward slope of about 35° on the side facing the road. On fills the curbs should have a vertical face. For fills more than 5 ft. deep, the concrete pavement should be widened to 16 or 18 ft. and a vertical curb 6 in. high should be constructed. The fills should be at least 6 ft. wider than the pavement, leaving room for a guard fence outside the curb. A similar type of construction is recommended for 'two-track' roads on steep grades.

Oil lands withdrawn from entry on July 1, 1914, included 4,758,163 acres, 230,400 in Arizona, 1,550,848 in California, 87,474 in Colorado, 414,720 in Louisiana, 1,952,326 in Utah, and 522,395 in Wyoming. During the year ended June 30, 1915, additional withdrawals were made in Wyoming covering 197,073 acres, and 137,517 acres was restored to entry. In California, 43,301 acres was restored to entry. The total amount of withdrawn land on June 30, 1915 was 4,774,418 acres. A large part of the land withdrawn in each of the States is patented although no accurate computation has ever been made. In California it is estimated that about 1,000,000 acres of the land within the withdrawn area is patented, leaving about 500,000 acres actually affected by the withdrawal orders.

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Specifications for Plain Concrete Floors

The following specifications are suggested by the Portland Cement Association for the construction of two-course concrete floors:

GENERAL

These specifications apply to plain concrete floors subjected to considerable wear, and cover the preparation of the sub-base and the laying, finishing and curing of the floor.

MATERIALS

1. **Cement**: The cement shall meet the requirements of the Standard Specifications for Portland Cement of the American Society for Testing Materials adopted August 16, 1909, with all subsequent amendments and additions thereto adopted by said Society.

2. **Aggregates**: Before delivery on the job, the contractor shall submit to the architect or engineer a fifty-pound sample of each kind of aggregate proposed for use. These samples shall be tested and if found to pass the requirements of the specifications, similar material shall be considered as acceptable for the work. All aggregates used shall meet with the approval of the architect or engineer and shall fulfill the requirements of these specifications. In no case shall aggregates containing frost or lumps of frozen materials be used.

Fine Aggregate: Fine aggregate shall consist of natural sand, or screenings from hard, tough, durable crushed-rock or gravel, consisting of quartzite grains or other equally hard material, graded from fine to coarse, with the coarse particles predominating. Fine aggregate, when dry, shall pass a screen having 4 meshes per linear inch; not more than 25% shall pass a sieve having 50 meshes per linear inch, and not more than 5% shall pass a sieve having 100 meshes per linear inch. Fine aggregate shall not contain vegetable or other deleterious matter, nor more than 3% of clay or loam.

Fine aggregate shall be of such quality that mortar composed of one part portland cement and three parts fine aggregate, by weight, when made into briquets, shall show a tensile strength, at seven and twenty-eight days at least equal to the strength of briquets composed of one part of the same cement and three parts standard Ottawa sand, by weight. The proportion of water used in making the briquets of cement and fine aggregate shall be such as to produce a mortar of the same consistence as that of the Ottawa sand briquets of standard consistence. In other respects all briquets shall be made in accordance with the Report of Committee on Uniform Tests of Cement of the American Society of Civil Engineers.

Coarse Aggregate: Coarse aggregate shall consist of clean, durable crushed-rock or gravel, graded in size, free from vegetable or other deleterious matter, and shall contain no soft, flat or elongated particles. The size of the coarse aggregate shall be such as to pass a 1½-in. round opening and shall range from 1½ in. down, not more than 5% passing a screen having four meshes per linear inch, and no intermediate sizes shall be removed.

No. 1 Aggregate for Wearing Course: No. 1 aggregate for the wearing course shall consist of clean, hard, tough, durable crushed-rock or pebbles, free from vegetable matter, and shall contain no soft, flat or elongated particles. It shall pass, when dry, a screen having ½-in. openings and not more than 10% shall pass a screen having four meshes per linear inch.

No. 2 Aggregate for Wearing Course: No. 2 aggregate for the wearing course shall consist of clean, hard, tough, durable crushed-rock or pebbles graded in size, free from vegetable or other deleterious matter, and shall contain no soft, flat or elongated particles. The size of No. 2 coarse aggregate shall be such as to pass a 1-in. round opening and shall range from 1 in. down, not more than 5% passing a screen having four meshes per linear inch, and no intermediate sizes shall be removed.

3. **Mixed Aggregate**: Crusher-run stone, bank-run gravel or artificially prepared mixtures of fine and coarse aggregate shall not be used.

4. **Sub-base**: Only clean, durable material, such as gravel not exceeding four inches in the largest dimension, or steam-boiler cinders free from ash or particles of unburned coal, shall be used in the sub-base.*

5. **Water**: Water shall be clean, free from oil, acid, alkali or vegetable matter.

6. **Color**: If artificial coloring material is required, only mineral colors shall be used.

7. **Reinforcement**: The reinforcing metal shall meet the requirements of the Standard Specifications for Steel Reinforcement adopted March 16, 1910, by the American Railway Engineering Association.

8. **Joint Filler**: The joint filler shall be either a suitable elastic waterproof compound that will not become soft and run out in hot weather, nor hard and brittle and chip out in cold weather, or prepared strips of fibre matrix and bitumen as approved by the architect or engineer.

SUBGRADE

9. **Depth**:* (a) The subgrade shall not be less than eleven inches below the finished surface of the floor.

*When a sub-base is required, omit paragraph 9 (b). When a sub-base is not required, omit paragraphs 4 and 9 (a), 13 and 14. Unless paragraph 9 (a) is omitted 9 (b) is void.

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(b) The subgrade shall not be less than five inches below the finished surface of the floor.

10. **Preparation**: All soft and spongy places shall be removed and all depressions filled with suitable material which shall be thoroughly compacted in layers not exceeding six inches in thickness. The subgrade shall be thoroughly tamped until it is brought to a firm, unyielding surface.

11. **Deep Fills**: All fills shall be made in a manner satisfactory to the architect or engineer. The use of muck, quicksand, soft clay, spongy or perishable material is prohibited.

12. **Drainage**: When required, a suitable drainage system shall be installed and connected with sewers or other drains indicated by the engineer.

Sub-base

13. **Thickness**: On the subgrade shall be spread a material as hereinbefore specified, which shall be thoroughly rolled or tamped to the surface at least five (5) inches below the finished grade of the floor. On fills, the sub-base shall extend the full width of the fill.

14. **Wetting**: While compacting the sub-base, the material shall be kept thoroughly wet, and shall be in that condition when the concrete is deposited.

Forms

15. **Materials**: Forms shall be free from warp and of sufficient strength to resist springing out of shape.

16. **Setting**: The forms shall be well staked or otherwise held to the established lines and grades and their upper edges shall conform to the established grade of the floor.

17. **Treatment**: All wood forms shall be thoroughly wetted and metal forms oiled before depositing any material against them. All mortar and dirt shall be removed from forms that have been previously used.

Construction

18. **Size of Slabs**: The slabs or independently divided blocks when not reinforced shall have an area of not more than 100 sq. ft. and shall not have dimensions greater than 10 ft. Larger slabs shall be reinforced as hereinafter specified.

19. **Thickness of Floor**: The thickness of the floor shall be not less than five inches.

20. **Width and Position of Joints**: When required by the architect or engineer in charge, a ½-in. space or joint shall be left between the floor and the walls and columns of the building.

21. **Protection of Edges**: Where required by the engineer in charge, the joints shall be protected by metal. Unless protected by metal, the upper edges of the concrete shall be rounded to a radius of ½ inch.

Measuring and Mixing

22. **Measuring**: The method of measuring the materials for the concrete or mortar, including water, shall be one which will insure separate uniform proportions at all times. A sack of portland cement (94 lb. net) shall be considered one cubic foot.

23. **Machine Mixing**: When mixing by machine, a batch mixer of an approved type shall be used. The ingredients of the concrete or mortar shall be mixed to the specified consistence, and the mixing shall continue for at least one minute after all materials are in the drum. Raw materials shall not be permitted to enter the drum until all the material of the preceding batch has been discharged.

24. **Hand Mixing**: When it is necessary to mix by hand, the materials shall be mixed dry on a water-tight platform until the mixture is of uniform color, the required amount of water added, and the mixing continued until the mass is homogeneous and of uniform consistence.

25. **Re-tempering**: Re-tempering of mortar or concrete which has partly hardened; that is, remixing with or without additional materials or water, shall not be permitted.

Concrete Base

26. **Proportions**: The concrete shall be mixed in the proportions, by volume, of one sack portland cement, 2½ cu. ft. of fine aggregate and 5 cu. ft. of coarse aggregate.

27. **Consistence**: The materials shall be mixed wet enough to produce a concrete of a consistence that will flush readily under slight tamping, but which can be handled without causing a separation of the coarse aggregate from the mortar.

28. **Placing**: After mixing the concrete shall be handled rapidly and the successive batches deposited in a continuous operation, completing individual sections to the required depth and width. Under no circumstances shall concrete that has partly hardened be used. The forms shall be filled and the concrete struck off and tamped to a surface the thickness of the wearing course below the established grade of the floor. The method of placing the various sections shall be such as to produce a straight clean-cut joint between them so as to make each section an independent unit.

29. **Reinforcement**: Slabs having an area of more than 100 sq. ft., or having dimensions greater than 10 ft., shall be reinforced with wire fabric, or with plain or deformed bars. The cross-sectional area of metal shall amount to at least 0.041 sq. in. per linear foot transversely and parallel to centre line of floor. The reinforcement shall be placed upon, and slightly pressed into the concrete base, immediately after the base is placed, and shall not cross joints and shall be lapped sufficiently to develop the full strength of the metal.

Wearing Course

30. (a) **Proportions for Mixture No. 1.**: The wearing course shall be mixed in the proportions of one sack of portland cement, one cubic foot of fine aggregate and one cubic foot of "No. 1 Aggregate for Wearing Course."

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30. (b) **Proportions for Mixture No. 2.**: The wearing course shall be mixed in the proportion of one sack of portland cement, one and a half cubic feet of fine aggregate, and two cubic feet of "No. 2 Aggregate for Wearing Course."†

31. **Consistence**: The mortar shall be of the dryest consistence possible to work with a sawing motion of the strikeboard.

32. **Thickness**:‡ The wearing course of the floor shall have a minimum thickness of one inch.

33. **Placing**: The wearing course shall be placed immediately after mixing. It shall be deposited on the fresh concrete of the base before the latter has appreciably hardened, and brought to the established grade with a strikeboard.

34. **Finishing**: After the wearing course has been brought to the established grade by means of a strikeboard, it shall be worked with a wood float in a manner which will compact it thoroughly and provide an even surface. When required, the surface shall be steel-troweled, but excessive working shall be avoided.

35. **Coloring**: If artificial coloring is used, it must be incorporated with the entire wearing course, and shall be mixed dry with cement and aggregate until the mixture is of a uniform color. In no case shall the amount of coloring exceed 5% of the weight of the cement.

PROTECTION

36. **Treatment**: As soon as the finished floor has hardened sufficiently to prevent damage thereby, the floor shall be covered with at least one inch of wet sand, or two inches of wet sawdust, which shall be kept wet by sprinkling with water for at least ten days. The freshly finished floor shall be protected from hot sun and drying winds until it can be sprinkled and covered as above specified.

37. **Temperature Below 35°**: If at any time during the progress of the work the temperature is, or in the opinion of the architect or engineer will within 24 hours drop to, 35°F., the water and aggregates shall be heated and precautions taken to protect the work from freezing for at least five days. In no case shall concrete be deposited upon a frozen sub-base.

STATE ACCIDENT INSURANCE IN CALIFORNIA

The April issue of the *Compensation News Bulletin* issued by the State Compensation Insurance Fund gives considerable information regarding State accident insurance since the passage of the Compensation Act. To December 31, 1915, the total compensation and medical payments made on injury cases amounted to $269,847. When all future payments have been made on claims for injuries sustained before that date, it is estimated that these claims will have cost $446,006. The refund to policy-holders for 1914 and 1915 amounts to $165,000, and further refunds will be made to policy-holders of these years when the legal reserves have been released. The average refund is about 15% of the original premiums. When the risk shows no profit, no refund is made.

The bulletin calls attention to a recent decision of the Supreme Court sustaining the Compensation Act. Some space is also devoted to the new Rating Law, under which the Insurance Commissioner controls rates.

STATISTICS OF AREA AND PRODUCTION OF CALIFORNIA OILFIELDS

The total area of proved oil land in California is given as 80,702 acres in a statement recently issued by the State Mining Bureau. Of this, the Coalinga field, all in Fresno county, contains 12,218 acres. Kern county contains 55,842 acres, 3115 acres being in the Lost Hills and Belridge fields, 1086 acres in the McKittrick field, 6974 acres in the Kern River field, and 44,667 acres, or more than half the oil land in the State in the Midway-Sunset field. San Luis Obispo county contains 202 acres of oil land, 30 at Arroyo Grande and 172 in that part of the Midway-Sunset field which extends across the Kern county line. There are 6030 acres of oil land in Santa Barbara county, 5900 in the Santa Maria and Lompoc fields and 130 at Summerland. The various small fields in Ventura county contain 749 acres. Los Angeles county contains 2326 acres of oil land, 117 acres being in the Newhall field, 949 acres in the Salt Lake field, 380 acres in the Los Angeles City field, and 880 acres in the Whittier-Fullerton field. Orange county contains 3305 acres of oil land, all in the Whittier-Fullerton field. Santa Clara county contains 30 acres of oil land near Sargent. Of the total area, 67,888 acres is in the San Joaquin valley, and 12,814 acres in the Coast fields.

The Bureau wisely refrains from making any estimate of the ultimate production, but states that the average will probably be less than 50,000 bbl. per acre. Using this figure, the total production would be about 4,000,000,000 bbl. provided no new fields are discovered and the proved territory in the old fields is not extended. An estimate recently published in the Standard Oil *Bulletin* gives 851,260,420 bbl. as the total production of the State up to December 31, 1915, divided as follows: 181,747,075 bbl., or 26,061 bbl. per acre from the Kern River field; 45,631,573 bbl., or 42,018 bbl. per acre from the McKittrick field; 216,336,533 bbl., or 4825 bbl. per acre from the Midway-Sunset field; 17,278,295 bbl., or 5547 bbl. per acre from the Lost Hills and Belridge fields; 70,692,981 bbl., or 11,982 bbl. per acre from the Santa Maria and Lompoc fields; 17,616,305 bbl., or 20,342 bbl. per acre from the Ventura County and Newhall fields; 49,679,079 bbl., or 37,230 bbl. per acre from the Los Angeles and Salt Lake fields; 82,748,993 bbl., or 19,773 bbl. per acre from the Whittier-Fullerton fields; and 2,066,989 bbl., or 15,900 bbl. per acre from the Summerland field. The remaining 909,902 bbl. came from various small areas throughout the State.

†When 30 (a) is specified 30 (b) is void, and vice versa.

‡When No. 2 aggregate for wearing course is specified, the wearing course shall have a minimum thickness of one and one-half inches.

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The Gasoline Question

By AN OCCASIONAL CONTRIBUTOR

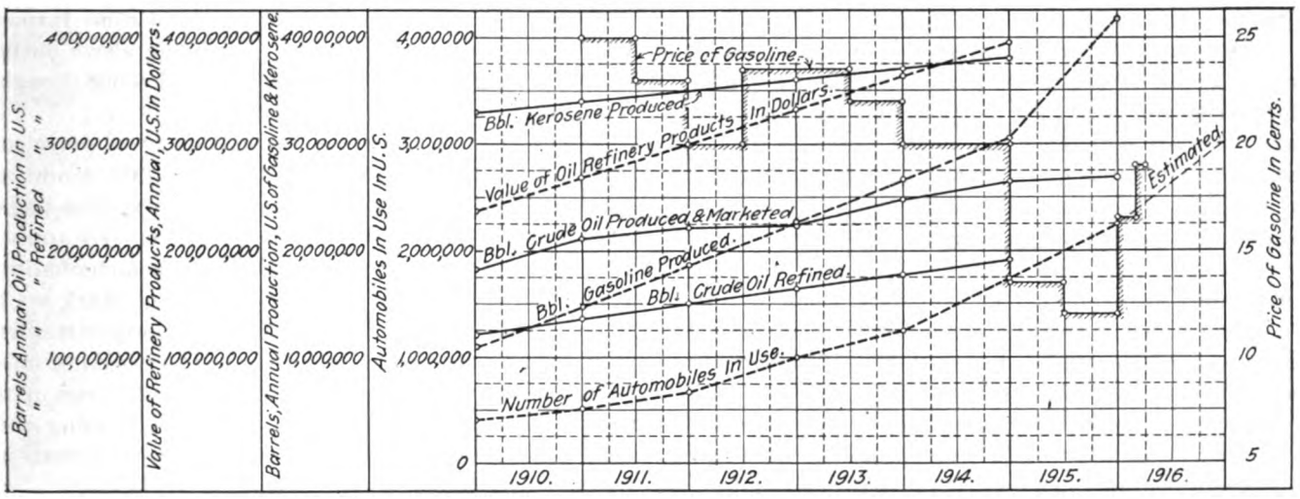
Much has been written lately in a hysterical way, and much ranting has been done in legislatures and in the halls of Congress on the subject of gasoline and its sudden rise to what seems to be considered by the consuming public an iniquitous price. Succinctly, the public wants to know if the rise is warranted; is it due to that industrial Machiavelli, Standard Oil. Parenthetically it may be asked, is the present level of prices, in view of conditions, at all abnormal?

Be the answer what it may, the public's interest lies largely in what can reasonably be expected in the future in regard to both supply and price for what has become a most important staple of commerce. The public asks the professional man on the one hand, what avenue of relief is there for this new situation, and on the other hand requests the Attorney-General to state what, if the cards are stacked by the aforeascribed machiavellian trust, is he going to do about it?

The question has had the dignity of a resolution passed by the U. S. Senate, where, unfortunately, political fences are sometimes built in anticipation of coming elections, and has for months occupied the attention of the Federal Trades Commission. In reply to the Senate resolution our well-informed Secretary of the Interior reported to Congress clearly, at length, and to the point that it is only a natural situation, while the newly-created Trades Commission has rendered thereon a preliminary though somewhat non-committal report. The following data, observations and impressions are taken mainly from these reports, and from the U. S. Census, as well as from published interviews with prominent factors in the oil business—the producers and refiners themselves.

In the ordinary course we look for guidance to general principles. The law of supply and demand is one of these, and has been generally accepted as ruling in everyday affairs. There is no reason why it should not apply in this case, barring special conditions that obtain in every particular industry.

The graphic exhibit, Fig. 1, gives the relation for the past five years between the production of the raw product, crude oil, and the various elements that enter into an intelligent comprehension of the problem. There are, of course, other factors, but these are the leading ones (referring only to the production of the United states), to wit:



Graphic Diagram showing relation for past Five Years, between production and consumption, of various elements of the Petroleum Industry, in the United States, as compared with the increase in number of Automobiles in use.

FIG. 1.

Group 1. (*a*) The amount of crude oil produced annually; (*b*) the amount of crude oil refined annually (the difference being consumed as fuel?); (*c*) the amount of kerosene produced annually, and considered as consumed (which it is not, of late).

The curves for these three elements are substantially parallel and indicate what might be considered a normal situation in the oil business.

Group 2. (*d*) The amount of gasoline produced annually, and considered as consumed; (*e*) the number of automobiles in use in the United States; (*f*) the total value of the refinery products.

The elements of Group 2, it will be seen, are also roughly parallel, and the sharp rise of these curves over those of Group 1 carries its own meaning. Unfortunately for the public, the raw product, crude oil, is in

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Group 1, and it is more likely than not to remain in that position if those who are best qualified to speak are to be trusted. The report of the Secretary of the Interior to Congress presents data showing that the known oil reserves of the country have been drawn upon or depleted to the extent of 50%, ranging from 34% in California to 75% for the Eastern oilfields. The amount remaining, about 7,500,000,000 bbl., is not all commercially extractable. Untested areas, of course, surround the proved oilfields; these may be assumed to be probably productive, but their value is problematic. It is the general belief that 300,000,000 bbl. is our maximum annual productive capacity, and since our oilfields have for years produced two-thirds of the world's output, and have therefore supplied two-thirds of the world's consumption (since the European War about four-fifths, because of the practical exclusion of the Rumanian and Russian oilfields) there must be a re-adjustment soon somewhere.

Superimposed upon the curves of Fig. 1 is the course of the average retail price of gasoline on the seaboard of California in recent years; the authority therefor is the *Oil Age* of Los Angeles, in its April issue. The exhibit speaks for itself; the purport of it is that the average price per gallon for the period has been 20c., and that for relatively short intervals only has it been below the average. The price today is 10% lower than it was the day the European War broke out. Prices in different parts of the United States vary both as to time and amount, being higher on one coast than the other at a given date; at present the differential in favor of this coast is 6c. per gallon, hence gasoline is now flowing eastward from San Francisco.

The obvious disturbing factor in prices at the end of 1914 was the 'bringing-in' (in March) of the famous Cushing oil-pool in Oklahoma, with its phenomenal yield of high-gravity refining oil, rich in gasoline. Its history and the attendant disturbance to crude-oil values are shown by Fig. 2. The price of gasoline has followed, and has been more influenced, by the story of Cushing than by either the European war or our domestic business disturbances or by the volume of gasoline exports. The effect was psychological as well as real; to which I may add that when the press-agents of the auto-makers at Detroit spread abroad the report that for the first quarter of the year 1916 the purveyors of this item of luxury as well as business necessity shipped just twice as many carloads of finished cars as they did for the corresponding quarter of 1915, more psychology as well as more business acumen gets the scent of what is coming: a further threatened shortage of gasoline, and if not yet real, certainly threatened. If 650,000 new cars were added last year to the sum total running, it is no idle guess to state that a million will be added to the number in the current year of American prosperity: a single Detroit firm announces that it alone expects an output of 500,000 cars in 1916!

The most potent and obvious fact in the situation is that the consumption of gasoline will continue to expand in direct ratio with the expansion of the uses of the internal-combustion engine, particularly the automobile, the auto-truck and tractor, and the motor-boat. There is some hope of finding limited substitutes for gasoline as fuel for internal-combustion engines, but these substitutes will most likely also be petroleum-derivatives rather than of non-petroleum origin, such as alcohol. If the demand for gasoline or its equivalent continues to expand at its present rate, and if the supply of the raw product, its parent, is fixed within certain limits, there can be but one solution of the problem of how to meet the coming demand, and that is to increase the yield of the desired product from the crude-oil stock, or to increase the amount of oil that is consumed for refining by reducing the quantity consumed directly as fuel, which would be only a qualified relief under present conditions.

The expression "present conditions" is used advisedly, for but 15% of the crude-oil yield last year was made into gasoline, representing probably the maximum obtainable under current refinery methods, or the present state of the art. In other words, if there is to be an increase in the supply of gasoline it must come through improved methods of refining. With the above outline of the problem there are offered the following thoughts upon some of its possible solutions.

It was vaguely known in the chemistry of petroleum for more than fifty years that under certain conditions crude oil could be 'cracked' and made to yield a higher percentage of the more volatile products. To apply a process therefor and make available commercially a principle—if such could be done—was the mark set by many inventors and some few actual experimenters. 'Cracking,' in its simple analysis, means breaking up or disassociating by heat and pressure the molecules of the heavier hydrocarbons of crude oil and re-forming them into molecules of the lighter elements. The first important commercial advancement in this direction was gained in 1913 in a process brought out by W. M. Burton (U. S. Patent 1,049,667), wherein the distillates, or the secondary light products of the ordinary refinery, could be re-run in a still having the form of the common still, but working under about 75-lb. pressure. By this method the increase in yield of gasoline is pronounced. The process was at once taken up by the Standard Oil Co. of Indiana, and it is reported that 3,000,000 bbl. of gasoline was made with it last year; truly an encouraging advancement. But it was reserved for the year 1915 to produce what promises to be a greater achievement—that of Rittman. The eyes of five million users of internal-combustion engines are fixed upon it, asking whether this is a real star to which they can hitch their wagon, the allied petroleum products industries are scanning its possibilities, and the scientific world awaits confirmation of an indicated revolutionary discovery, proved by the commercial application of the new principle.

Briefly, what Rittman has done is to devise a practical method of applying the 'cracking' principle to its logical purpose; his method indicates the ability to convert any crude oil of whatever base (asphalt or paraffine, or mixed) or any product or any residue from such oils

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from present refineries, into but three products:

1. Fixed gases, which can be used in the reduction process itself.

2. Fixed carbon in the form of coke, lampblack, etc., which always have a good market-value and a market not easily surfeited.

3. An oil, all of which can be made by repeated distillations into gasoline of any desired gravity, or by a different manipulation of the pressures and temperatures used, can be converted into the aromatic hydrocarbons, benzene, and toluene.

This discovery, preceded by years of elaborate experiments in the laboratory at Columbia University, in which the groundwork of the chemical principles involved was thoroughly worked out, has been demonstrated on a commercial scale with full-sized plants. What Rittman apparently has done is to go a step in advance of Burton, who had already achieved success, but upon radically different lines. Burton dealt with distillates, or intermediate products only, and with moderate pressures (75 lb.) with combined liquids and vapors. Working on the knowledge that chemical control was more easily obtained when dealing with vapors than with liquids, Rittman at once converted all his oil into vapor, and by adopting a vertical tube of relatively small diameter for the working appliance to permit of using high pressures and better heat-control, in place of the large horizontal still of ordinary form, there was thus given him, *ipso facto,* the medium for some radically different and improved results. This is proved by the fact that from the same apparatus there can be obtained, by different manipulation and by varying the conditions of heat and pressure, either the aromatic hydrocarbons, benzene, and toluene, used respectively in the dye and the explosives industries, or the sweet hydrocarbons such as gasoline. It is too early to predict the ultimate effect a wide adoption of the process will have upon the ramified markets of crude oil and its products. If it proves a commercial success—in all that the term implies—the volume of production possible from new Rittman plants can hardly influence the gasoline market for two years to come, for it takes time to build plants and to do the necessary experimentation with individual oils. If the Rittman process does not prove successful on large-scale operations, there does not appear in sight much other relief in the way of improved processes to extract a higher yield of gasoline from crude oil. Considering the fact that economists place so high a value on our reserves of crude oil as to maintain that their primary use should be limited for purposes and uses for which there are no substitutes in nature—as for instance, lubricants and refined derivatives—there must be a profound readjustment of the bases of things pertaining to oil in the next five years, if not sooner. For one thing, the burning of it under boilers in unrefined state to generate steam must stop.

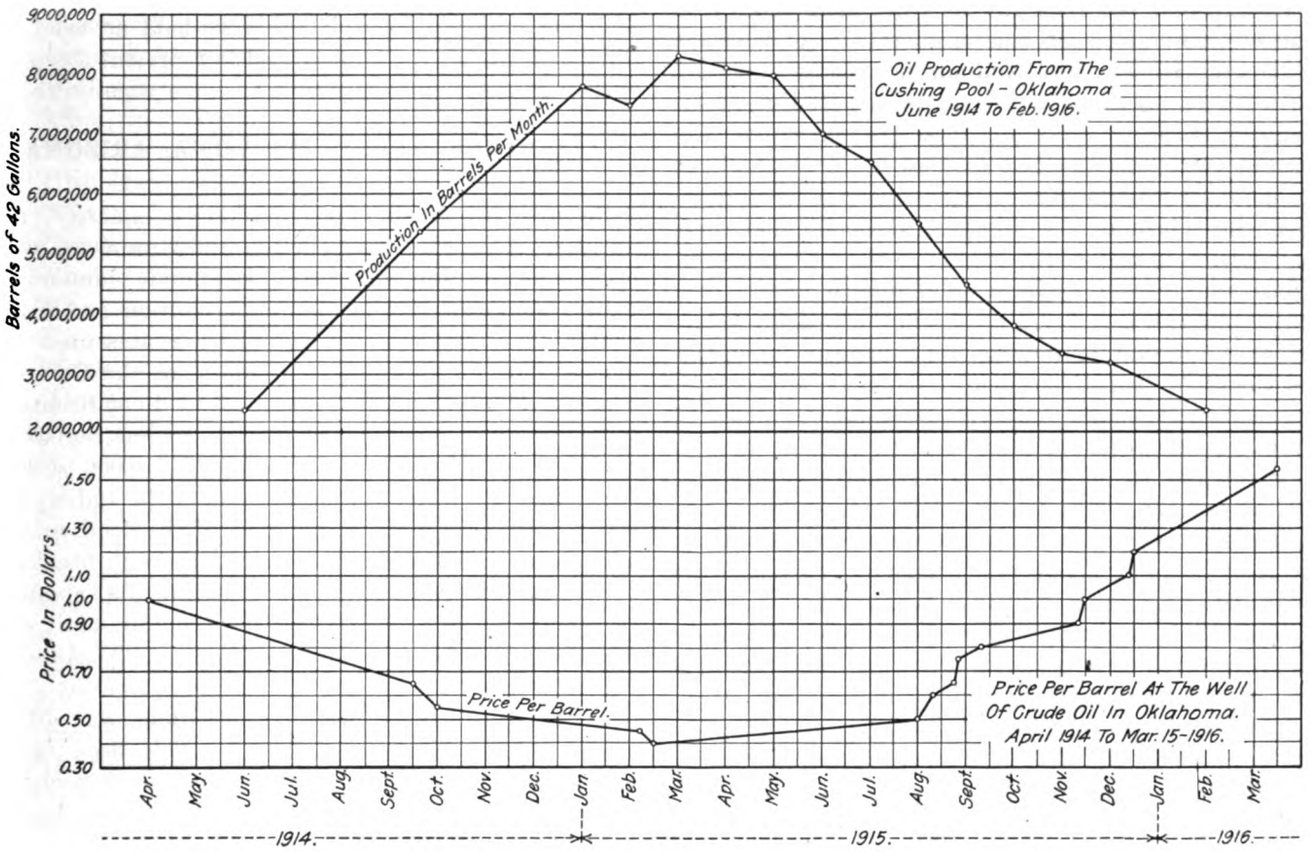

FIG. 2.

If the agitation over the price of gasoline yields no greater practical result than to call attention to the effect

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of supply and demand upon the raw product—crude oil—and to the status of the refining art, it will have served a good purpose. If it will also bring out some fundamental facts about the oil business, as for instance (*a*) that its pursuit should occupy only those equipped with experience and highly efficient organization, (*b*) that the business is one requiring enormous amounts of capital, especially liquid capital that must be available on a moment's notice to throw into any new situation such as is created by the 'bringing-in' of a new oilfield, like Cushing, or the discovery of a new process that overnight will scrap the machinery of a plant covering 100 acres, (*c*) that the risks involved are more hazardous than any other form of mining operation (of which it can be considered a part), and mining is looked upon by the business world as involving the superlative of all business risks—if some of these fundamentals are brought out by the gasoline discussion, important light for guidance will be thrown upon many related questions. To substantiate or illustrate the point that enormous capital is required to engage in the oil business in a particular region we have only to turn to two particular ventures here in California in the past five years. One is the history of the General Petroleum Company and the other that of the Shell Company. It has been regarded as axiomatic that it required $25,000 worth of capital to 'turn over' one barrel of oil per day, that is, to buy or produce one barrel per day, and transport, refine, market, and distribute the products therefrom. The records of these two enterprises are much to the point: one is of domestic origin and primarily represents the consolidation of prior local interests, having only local capital to finance its operations, and whose affairs are now in process of re-organization, while the other is a branch of the Royal Dutch-Shell combination operating in most of the world's oilfields and having unlimited capital on which to draw. Data are not available to fix the sum of the first company's investment, but the latter is reputed to have expended thus far $30,000,000 to handle 10,000 bbl. per day production of the 250,000 bbl. currently produced each day in California, and has not yet concluded the capital expenditures necessary to put itself in the position to compete at all points in the Pacific Coast markets with the markets previously established.

In view of the above it would seem beside the question to rail against the undeniably large profits, as such, that lie in the oil business for those whom the public expects shall provide a gallon of gasoline at any hour of the day and every day in the year and at any consuming point on any continent. Acquired necessities impose obligations and for these obligations (and facilities) we must pay a good price whether or not we want to do so, so long as enormous sums, which the public does not provide, are required first to find at its own risk a commercial oil deposit, and then to produce, transport, refine and distribute the product. The point where artificially controlled conditions show nearest the surface is in the monopoly that goes with the pipe-lines that transport the crude oil from the well to the refinery, yet, as these are but one link in a longer chain, a breach at that point can hardly affect the problem in its larger aspect. If a conspiracy does exist to boost and maintain prices of gasoline, which statement the exhibit in Fig. 1 fails to substantiate, then the Standard Oil, which, as reported, refines 60% of our gasoline, emerges in the preliminary report of the Federal Trades Commission with the record of supplying the same, considering large averages over the whole of the country, at from ¼ to ½ cent under what the consumer pays the independent. Counting the experience, capital, and organization of the Standard, this is surprising mainly to those who lack familiarity with the subject. In saying this we hold no brief for Standard Oil, for the term is used to represent a type of operations rather than a specific business organization.

FLOOD DISCHARGES AT YUMA, ARIZONA

Records for flood-height, discharge, quantity, and duration of peak in the Colorado and Gila rivers were broken during January, 1916. Beginning January 18 with a gauge of 16.5 at the Yuma station and a discharge of 7000 second-feet, which represented the normal flow for this season of the year, the Colorado began to rise, mainly as a result of flood conditions on the Gila until on January 22 the gauge registered slightly over 34, with a discharge of 210,000 second-feet. The lower reservation levee near the Indian Hill was topped a little before the crest of the flood, and an additional 15,000 second-feet passed through breaks in the levee. The peak of the flood continued at about 34 ft. for six hours, after which it fell rapidly until January 24, when heavy rains near Parker, 200 miles up the river caused a second rise in the Colorado. The peak of this flood at the Laguna dam was 70,000 second-feet on the 29th and 30th. This flood met a second rise of the Gila river and gave a flood discharge of 162,000 second-feet at Yuma on the 31st, besides 10,000 second-feet flowing through the breaks in the levee already mentioned.

Of a total of about 16,000 acres in the Indian Reservation unit of the Yuma project of the Reclamation Service, 10,000 acres was flooded. Of 50,000 acres in the Yuma Valley unit, only about 3000 acres was flooded. About 97,000 cu. yd. of material was washed out of the various levees and canals, but this was replaced rapidly. Considerable damage was done in the town of Yuma, particularly to adobe buildings.

Costs of maintenance of the pavement on concrete highways in Illinois, were given at the National Conference on Concrete Road Building. Bituminous material was used to fill the cracks. The cost of maintenance ranged from $0.001 to $0.0057 per sq. yd. of pavement or from $9.40 to $53.50 per mile for a 16-ft. pavement. The average cost where a portable heating-kettle was used was $0.0032 per sq. yd., and where an automobile truck was used, $0.0022 per square yard.

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The Work of the Naval Consulting Board*

The Naval Consulting Board was organized in the fall of 1915 to provide the means whereby our Navy might be able to avail itself of the technical ability and the native ingenuity of all of our people. Its work was divided into the following subheads, by the appointment of committees thereon:

1. Chemistry and physics.
2. Aeronautics, including aero-motors.
3. Internal-combustion motors.
4. Electricity.
5. Mines and torpedoes.
6. Submarines.
7. Ordnance and explosives.
8. Wireless and communications.
9. Transportation.
10. Production, manufacture, and standardization.
11. Ship construction.
12. Steam engineering and ship propulsion.
13. Life-saving appliances.
14. Aids to navigation.
15. Food and sanitation.

All of the members of this Board are men of note. Most of them have given up practically their whole time to its work; they do not only pay their own traveling and hotel expenses, but also all of the office expense, even stationery and postage. No public funds are available for this purpose.

To show how this work has grown from its original conception as a Board advisory to the Navy Department, the first confidential blank sent to the associate members by the secretary in New York, is headed 'Industrial Inventory, 1916, for Army and Navy—a strictly confidential non-partisan, non-political, and wholly patriotic inventory of our country's manufacturing and producing resources.'

In the beginning there was some criticism of the functions of this Board, chiefly by those who were most likely to receive benefit from its operations. It is only fair to state that their adverse opinions were based upon wholly erroneous impressions. The Navy men withdrew into their shells and have only recently come out, when they found that their first impressions were wrong. It seemed to be the general opinion that the Board would be all right if it waited quietly for the Navy to refer its problems; whereas the Board seemed to think its function was to go out and dig up problems to work on, and turn over the results to the Navy. In order to avoid antagonisms and possible further misunderstandings, its name was changed from the 'Naval Advisory' to the 'Naval Consulting Board.' Very soon, however, the officers became convinced that the Board was not for self-advertising, but for business, and was intending to take a creative and constructive part in the handling of the affairs of the Department, not in conflict, but wholly in common with the Naval Officers. As soon as this view became really well founded, immediate and instant support of the Navy in general was assured. These feelings were but natural in view of the original misunderstanding which led the Naval Officers to believe that the Board was to sit in criticism on the action and the policies of the Department, which contains real experts, more skilled in their lines than anyone else in the country. Now, happily, these same experts have joined forces with the Consulting Board, and the results are exceedingly satisfactory.

As illustrating the change of feeling on the part of the Naval Officers as soon as they found that the Board was organized really to help, a few of the hard nuts the Navy had to crack were passed up to the Board for solution; for example, to discover the cause and to provide a cure for the erosion in the bore of guns; to suggest a means of coupling and uncoupling the high-speed cruising engines of destroyers when under way; to provide means whereby a submarine can see longer distances under water; to provide a more efficient aero-motor. These are merely the beginnings, there being eight or ten other problems of similar magnitude.

About this time the officers received a rather startling suggestion from the representatives on the Board of the automobile industry, namely, an offer to provide free instruction in gas-engine design, manufacture, and operation, to between 300 and 500 naval aviators; the course to last six months, to be accompanied by frequent lectures, and to be given without charge.

The result now is that the admirals of the general advisory council are now working with the Board in the most complete harmony and with the greatest enthusiasm, which means, of course, that the entire Naval service has become converted.

Early in this year, the President requested the Board to enlarge its usefulness to the Government by nominating, for the approval of the Secretary of the Navy, representatives for each State in the Union, from the members of the five national technical societies that had furnished the members of the Board, to assist in the work of collecting data for use in organizing the manufacturing resources of the country for public service in case of emergency. The results of this action have been published widely by the press of the country. In each State the associate members constituting the State Boards of Directors have organized for business by the election of a chairman and secretary. They are now organizing a corps of field aides selected from the combined member-

*From paper presented at the meeting on Military Preparedness held under the auspices of the five national engineering societies at San Francisco, May 2, 1916, by A. H. Babcock, associate member of the Board.

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ships of the five technical societies within the several States. This work having been completed, the organization is not to be disbanded, but is to be continued in order to insure to the Government the backing of the full industrial strength of the country in case of need.

The present work will call for the co-operation of approximately 30,000 engineers in the making of a card-index survey of American industry so that it may be prepared for national defense. Through the great power of advertising, we expect to rouse manufacturers, workingmen, business men; in fact, the whole country to the vital need of making industry the basic line of defense so that if necessity arises it can supply munitions quickly and abundantly. This is not a war measure, but a peace measure. As such it will be supported by both the militarists and the pacifists. So the slogan of the advertising campaign has been adopted—"National Defense and International Peace." While the primary object, of course, is service to the country, it is manifest that this work of the engineers will be of the greatest service to industry in times of peace; for if industry is thoroughly mobilized for defense, it will be placed on a basis of efficiency to meet the keen competition that we may rest assured will follow the present war.

The work is essentially non-partisan in its nature. The political affiliations of both the members and the associate members of the Board are of no consequence whatever. We are concerned with only the benefit to the Nation; and to that end there have been called together practically all the technical men of this country, a movement perhaps unique in the history of national governments. Our military heads in Washington are largely, of course, graduates of the best technical schools; they have been taught the profession of fighting and are masters of that profession. We engineers are unable to tell these men how to do their work; but while these department heads have lived with military problems all of their adult years, we on the other hand have slept, eaten, and lived with the industrial problems of this country. The two questions are wholly distinct, and the masters of one cannot be masters of the other. The Naval Consulting Board is confronted then with the necessity of interlocking these two vast elements of our National life into a great working organization for the national defense. This we are about to do.

The European War has driven home to us that battles are now won not alone by fighting men, but also by the fighting industries of a nation. It has come down to which country can fastest and longest supply the munitions of war to the men on the fighting line. It has come down to the question of which country can fastest and in the greatest quantity supply shells to the guns, to speak of only one item of modern warfare. It has even come to the point, over sea, where the women of all classes, the wives and daughters of all classes, are going into the mills and factories at Saturday noon and are working seven-hour shifts until midnight of Sunday, in order that the mills may not be closed down that day, in accordance with the agreement made by organized labor as to the period of rest.

The number of factories now being operated under special arrangements with the British Government in the production of war materials is 2500. The average number of men and women in the proportion of about one woman to three men in each factory is 600, making a total of 1,500,000 operators. In addition to this, the number of high-class modern machine tools, mostly semi-automatic, to carry out the work in these factories must be something enormous. After the War is over, this country, unless a great advance is made in the machine-tool equipment of our shops, will be at a hopeless disadvantage in any effort to compete with the production of these British factories in marketing outside of our own country.

Now when warfare gets down to this basis, it becomes not merely a question of the ability of army and navy heads; there is brought into action every bit of industrial brains of a country in arms. We here in America must organize, and organize from now on, behind the men of the Army and Navy. We must make them sure that they have the full and intelligent support of American industry, and to do this we must work in times of peace and not wait until the eleventh hour strikes.

In approaching the entire broad problem of industrial preparedness, special pleadings in oratory or in print are not sufficient. There must be a plan, and it is a very definite practical plan which is even now under way.

There are three distinct initial steps. The first is to find out what American industry actually can produce in munitions of war. The second is to apply that knowledge in a practical way which will put the plants of this country into the service of the Government behind the Army and Navy. The third step is to form such an organization of skilled labor as will not get off the job when war comes, that will not allow skilled workers to go to the front only to be pulled back later, more or less demoralized, to tasks from which they should never have been taken. It is now well known that allowing skilled labor to enlist at the outbreak of hostilities created a serious state of affairs in the factories of England and France.

In the first step, that of making the industrial inventory, we cannot depend on any small corps of men or a board. The work must be done by the men who themselves have developed the industries of the country. In short, we must enroll and we are proceeding to enroll, American industry at its source. It is they who in the event of war must stand behind the industries, and we have called them into service in time of peace. The engineers are entering upon the work in the most serious and concentrated frame of mind.

The method of procedure will be, that under the direction of the chief statistician of the American Telephone & Telegraph Co., a man who is probably the leading business statistician in the country, trained to a national perspective, and whose services have been

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offered free by his company as a patriotic act, a minute, sweeping inventory of industry will be made by means of a carefully prepared printed form. The information called for in this form will be based upon what business men consider it necessary to know in arriving at the physical capacity of plants and their fitness and reliability for specific classes of output. Such information has never before been collected by any department of the Government.

The form calls for every bit of information necessary to the Government in time of war. Through the state directors, it will go to about 30,000 manufacturers who will pass it on to the best qualified engineer in the field, who will be known as a field aide. It has been passed upon by the Army and Navy authorities. Nothing has been left to guess-work. The program is the fruit of months of work and consultation with the best brains in the country. Everything is now ready for rapid movement.

But, and here we come to the second step, we will not stop at the mere gathering of this information. The card-index record, for that is what it will be, will not be enough for our purpose. We have accepted in the gravest spirit the lesson written in the industrial upheaval and in some instances the industrial paralysis that seized upon some of the nations at the start of the European War. We must not wait for war before we mobilize our resources. Therefore we have formulated a specific feasible plan whereby the manufacturers of the United States in times of peace shall maintain an annual minimum production of that part of the munitions of war best suited to their respective outputs. The Army and Navy Departments must be permitted, through legislative means, to place small annual minimum orders (educational orders), for the development of new sources of supply throughout every industry and throughout the entire country. The total volume of such orders will not be large. The payment should be made upon a cost plus a small profit basis, and the munitions or goods resulting from such orders should go to swell the reserve supply necessary for the plans for national defense. Through no other system may we hope to accomplish a real industrial preparedness.

To illustrate; suppose that we go to a great automobile company with an order for ten 3-in. shell-casings per year, to be produced at any time during the year, with the provisions that those casings must be delivered every year. Even an insignificant step like this will insure our purpose. The purchasing department of the company will learn how and where to buy materials; the manufacturing department will learn how to handle them; it will become familiar with the necessary jig and tool equipment, and with the heat treatment and standard of inspection; the engineering department will have the blue-prints and specifications essential, and all arguments will be gotten out of the way during the period of peace.

This minimum annual production, in its nature educational to the manufacturers, will be put through the factory in regular course and in such a manner as not to disturb the ordinary flow of business. The producer will be kept tuned to the highest pitch of effectiveness, the men at the work will know what they are doing, and finally every industry that is capable of serving the government, and everything that goes into the common term, munitions of war, will be co-ordinated, and a peaceful machine created which will require only the opening of the throttle to be set in motion on the outbreak of war. The minimum annual educational orders will be paid for by the Government on the basis of a reasonable but not excessive rate of profit to the manufacturer. This is a matter of common national endeavor; it goes straight to the best interests of manufacturers and laboring men alike, and there can be no better national insurance against war. In time of national emergency no manufacturing or producing concern can begin to turn out any product foreign to its usual line, without months of fatal delay, unless that concern during the normal times of peace has manufactured at least some small amount of such emergency product. The actual experience of hundreds of American manufacturers in connection with foreign munitions orders may be cited. The best manufacturing concerns in the United States have been and are months behind the promised times of delivery, even after nearly two years of the war, under the most favorable material and labor conditions, in a peaceful country undisturbed as to transportation and commerce, and with every advantage of manufacturing equipment.

The thing that has stirred up the business men of the Middle West during the past eighteen months has been the lesson they have learned in the making of war materials. It points a vivid moral to all our people. It all looked very easy when it started a year and a half ago. But listen to this lesson in unpreparedness. A concern in Cleveland got an order for 250,000 3-in. high-explosive shells. It was a simple enough looking job, just a question of machining. The forgings were shipped to them and they were to finish and deliver. It began to dawn on them when the forgings came, that this whole order, that looked like an eight months' job, was less than one day's supply of shells for France or England or Russia. In a little while they got up against the process of hardening. Fourteen months after work began there had been shipped and accepted 130,000 shells, and those, about half the order, are not complete. They still have to be fitted by the fuse maker, then placed in the brass cartridge cases with the propelling charge, and somewhere, some time, maybe, they will get on the battlefield of Europe. Up to the present none of them has been delivered there.

Now this is the situation in a high-class efficient American plant. This is what happened when it turned to making munitions of war. The same thing has occurred in so many Middle Western plants that their owners have made up their minds that if they are ever going to be called upon for service to their own country they must know more about this business. They feel that

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they are now liabilities to the nation and not assets in case of war. Proud as we may be of our industrial perfection, it has not worked here, and the country, particularly we in the West, may as well know it.

The Defense Committee of the United States Chamber of Comerce has been trying to figure out what sort of relation these private plants should have to the Federal Government in time of war, and they have reached the fundamentals of a plan. They feel that there should be, in the first place, a contract made in the open market as they would do business with any other customer, with this main difference: that in case of war there should be no excess profit to anybody arising out of the national necessity, and that the Federal Government should have the use of the private plants of the country in war-time at a living return to the stockholders. It is economically unwise that the stockholders should cease to have dividends from their investment, but the Government should have the right to take over the plants, with their personnel and equipment, on the basis of a living wage, so as to prevent the creation of a profit interest in war. They feel that it is very dangerous and un-American to set up any kind of system which will make any part of the community interested in forcing the nation into war, and that if there be war, every person, high or low, in this country must accept his share of the national sacrifice and, with all his heart and head, work in whatever place his ability can best be applied.

It is absolutely certain that the 30,000 concerns of which the Committee on Industrial Preparedness is about to make an inventory will gladly and with full patriotism support the great constructive work of this committee.

Perhaps the most valuable single lesson for us in the European War lies in the labor situation within the various countries. The wars of the future will be won not by the shedding of the blood of the laborer; but by the sweat of the worker in the mills and factories behind the lines. We have learned that our skilled labor in all lines must be kept at the lathe, the drill, and the forge. We have learned that each unit of our producing equipment must be kept as fully manned as is any vessel of our Navy. We have learned that for each million of men on the fighting line there must be a force of three millions of workers behind, and that the position of these workers in the mills must carry with it all the honor accorded the soldiers in the trenches. We propose to organize this industrial reserve now in time of peace. For it is in normal times of peace that each and every plan must be perfected upon which we can expect to rely with certainty in time of war.

The cost of removing an old concrete pavement on a highway in Pennsylvania is given in *Engineering and Contracting*. The pavement was 5 in. thick and was made of a 1:3:6 mixture. The total amount removed was 792 sq. yd. or 110 cu. yd. It was broken by hand, using bars and sledges. The total cost of removal was $0.2967 per sq. yd. or $2.08 per cubic yard.

CLEANING CEMENT SACKS BY MACHINERY

A machine for cleaning cement sacks, costing $900, permitted the reduction of the operating staff by three men and effected an annual saving of $2172 for an electric railway company in Cleveland, Ohio. This machine comprises four essential parts, a motor, a drum, an exhaust fan, and a dust-collector. The motor drives both the cleaning drum and the exhaust fan through a set of reduction gears. The octagonal drum is 12 ft. in diameter by 5 ft. wide, and is made with wooden sides and a half-inch mesh screen on the periphery. This drum is mounted on a shaft in a room which is as nearly air-tight as possible, and the motor revolves the drum at the rate of about 10 r.p.m. At one of the upper corners of the room an air-intake is installed and at the diagonally opposite corner an outlet leads through the exhaust fan to the dust-collector. As the drum revolves, the exhaust fan draws the air through it, removing the cement dust which is deposited on the floor of the room. A small amount of cement is finally taken out by the dust collector. One thousand sacks are placed in the drum at one time and after revolving it for thirty minutes and allowing five minutes for the dust to settle, the clean sacks are removed.

Previously this company found it necessary to employ three men to clean cement sacks. These men beat the sacks against a post, no attempt being made to save the cement, a considerable quantity being lost. These three men received 20c. per hour, and they cleaned approximately 1000 sacks a day. As this company uses 250,000 sacks of cement a year, the men were employed almost continuously. It was found that 1000 empty sacks weighed 1313 lb. After being machine cleaned they weighed 606 lb. or a reduction of 707 lb. The freight rate on sacks returned to the cement-mill was 8c. per hundred, hence a saving of 56c. per thousand sacks in the freight charges was effected.

In addition to the freight saving, the 707 lb. reduction in weight represented cement from the empty sacks. The annual saving was 442 barrels. Besides these two items the labor of the three men employed in cleaning the sacks was rendered unnecessary, hence an additional saving of $6 per thousand sacks, or $1500 per year, was made.

In a room adjoining the building occupied by the machine, a storage space for empty sacks was provided. This storage room is equipped with a stove and a special sewing-machine for mending torn sacks. During the winter months one of the men in the concrete gang who has become an expert at mending is detailed to the work of patching the sacks. As a rule this man mends between 200 and 250 sacks a day, for which he receives $2. Hence the expense of mending the sacks is small, and when they are in good condition they may be returned to the cement company for the rebate. A cement-sack bundling-machine also forms part of the equipment of this storage room.—Wilfred G. Astle in *Railway Engineering and Maintenance of Way*.

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Methods and Costs of Placing Concrete Lining for Lateral Canals on Orland Irrigation Project*

By A. N. BURCH†

To February, 1916, about 22 miles of laterals had been lined on the Orland project, in sections ranging from a few feet to 8800 ft. long. The cross-sections of the laterals lined have ranged from a bottom width of 2 ft. and vertical depth of 1 ft. to a bottom width of 8 ft. and vertical depth of 4½ feet.

Laterals originally designed for lining were built with 1:1 slopes; other laterals had 1½:1 and 2:1 slopes. On a distribution system covering 6000 acres recently taken into the project, all laterals were designed for lining, where a reduction of cross-sections and the elimination of drops would justify this course, as compared with building a larger earth-section and installing the necessary drops to reduce the grade.

On the project generally, lining has been placed in all fills; in the small laterals acquired from the old Stoney Creek company and placed within highway boundaries; in sections where seepage was excessive; as a protection over storm culverts and on curves, also at forks of laterals where, because of the number of structures, it was difficult to clean the ditches with teams.

For the longer stretches of the work a 4 ft. mixer, driven by a 3-hp. gas-engine, all mounted on trucks, is used. Small hand-mixing crews are employed on the short stretches. The aggregate used is run-of-bank material obtained from creeks in the vicinity of Orland. A 1:3:5 mixture is used, giving 1 cu. yd. of concrete in place for 1.1 bbl. of cement.

The mixer crew is composed of a foreman, with about thirty men and two teams. Nine men are employed at the mixer in wheeling and in placing and finishing, and from eighteen to twenty men in trimming the slopes and preparing the bottom for receiving the lining. One team is employed in hauling cement and one in hauling water and miscellaneous work. When it is possible to do so, water is run in the laterals and kept close behind the lining crew, thus reducing the distance of haul to the mixer and simplifying the process of wetting the completed work. No special tools are used in preparing the slopes and bottom for lining, the work being done with mattocks, picks, and square-ended shovels.

The mixer is usually set up at the side of the lateral in the centre of a 500-ft. section, making the maximum haul for concrete 250 ft., which was found to be about the greatest economical distance. As most of the lining is placed in fills, trenches are cut through the ditch banks to admit of a wheeling-plank, which, when placed, lands on a small turning-platform, from which an incline leads to the bottom of the lateral, and to additional boards on which the material is wheeled to the men placing concrete. End-dump barrows are used, and the material is dumped into a mud-box, from which it is shoveled to the slopes.

The mixing-crew is made up of one mixer operator, two shovelers for charging the mixer, three wheelers, and three men placing and finishing. Of the latter, No. 1 places the concrete to the required thickness (being guided by a templet), No. 2 compacts the material and finishes it roughly with a square-ended shovel, and No. 3 gives the final finish with a 5 by 18-in. long-handled Arrowsmith trowel, finally cutting the expansion joints with a straight-edge and a pointing trowel and smoothing them with a grooving tool. Before placing the lining the slopes are wet thoroughly by means of a force-pump attached to a water-wagon. The finished lining is kept wet from three to five days, depending on weather conditions. The average daily output of the mixer force is 25 cu. yd., and the maximum 30.3 cubic yards.

For short stretches, hand-mixing forces of about twelve men each are employed. From five to seven men are employed in mixing and placing, and about an equal number in preparing the slopes and bottom for receiving the lining. The same equipment is used and about the same arrangement in the operation of these crews as is the case with the mixer, except that the mixing-board is placed on timbers which span the lateral, the aggregates are wheeled on the board and dumped, and the concrete is shoveled into barrows in the bottom of the ditch, there being no incline over which to wheel the material. These gangs average about 12 cu. yd. per day, and when there has been a full day's run without any long moves have made 15 cubic yards.

There is little difference in the cost of lining whether the material be hand or machine-mixed, although the machine turns out a better and more uniform grade of concrete.

On the Orland project from October to June climatic conditions are favorable for this kind of work, as there are no temperatures low enough to affect the concrete adversely, and moisture conditions are usually such that the lining can be cured properly with little expense for wetting. During the summer, moisture conditions are reversed, and because of the thinness of the lining, it is necessary to wet it from two to four times per day until it is properly set.

*Reprinted from *Reclamation Record*.

†Project manager, U. S. Reclamation Service, Orland, California.

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Following are unit costs and related data:

	Cost per sq.yd.
Cement delivered on work	$0.0957
Gravel delivered on work	0.0408
Mixing concrete	0.0314
Placing concrete	0.0294
Sprinkling and protecting	0.0046
Preparing section for lining	0.0697
Field superintendence and engineering	0.0010
Maintenance of equipment	0.0022
Plant, arbitrary	0.0043
Total labor and material	$0.2791
General expense	0.0639
Total cost	$0.3430

Thickness of lining, 1½ in.
Total placed, sq. yd., 191,400.
Total cu. yd., 7900.
Cost per cu. yd., $8.26.
Average haul (round trip), gravel, 5 miles.
Average haul (round trip), cement, 6 miles.
Foremen, $3.20 per day to $95 per month.
Finishers, $3 to $3.20 per day.
Laborers, $2.40 to $2.60 per day.
Teamsters, with teams, $4.50 to $5 per day.
Cement, $2 per bbl.
Gravel, $1 per cu. yd.
Lumber, $14 to $22 per M. b. m.

OVERHEAD COSTS ON HIGHWAY CONSTRUCTION

A paper presented before the Pan-American Road Congress by Lamar Cobb, State engineer of Arizona, gives a summary of answers received from State highway departments to inquiries regarding overhead costs. As there is no uniformity among the different State highway departments in keeping cost-records, the comparison of costs can be only approximate. It should also be remembered that a low proportionate expense for engineering does not necessarily mean real economy.

Alabama: Cost of plans and surveys is 3% of cost of construction, engineering during construction is 5.9%, making a total of 8.9%. Administrative charges are not shown.

Arizona: Plans and surveys are 4.6% of cost of construction, engineering and inspection during construction, 4%, executive and administrative expense, 3.6%, making a total of 12.2% for overhead charges.

Connecticut: Plans and surveys are 0.88% of cost of construction, and engineering during construction, 4.94%, making a total of 5.82%. Administrative charges are not given.

Kansas: The total cost of engineering, including plans and inspection, is 5% of the cost of bridges and 8% of the cost of roads. Administrative charges are not given.

Maine: Plans and surveys are 2.27% of the cost of construction and engineering and inspection during construction, 3.58%, making a total of 5.85%. Administrative charges are not given.

Maryland: Plans and surveys are 0.5% of the cost of construction and engineering during construction, 3.2%. Other engineering and administrative charges are 4.7%, making a total of 8.4% for overhead expense.

Massachusetts: Plans and surveys are 1.9% of the cost of construction, engineering during construction, 4.5%, and administration 1.2%, making a total of 7.6% for overhead expense.

Minnesota: All engineering and supervision expense is 5.5% of cost of construction.

New Jersey: Plans and surveys 1.8% of cost of construction, other engineering 4.1%, making a total of 5.9%. Administrative charges are not given.

New Mexico: Engineering and inspection on bridge construction is 3% of cost of construction. On highway work, engineering and inspection are 5.2% of cost of construction and administration and office engineering, 7.42%, making a total of 12.62%.

New York: Engineering and inspection charges are 11.2% of cost of construction, and administration, 3%, making a total overhead charge of 14.2%.

North Carolina: Incomplete records give 4.06% of the cost of construction as the engineering and inspection charge. Cost of administration appears to be in addition to this amount.

Ohio: Engineering expense is 5.71% of the total cost of construction. Cost of administration appears to be in addition to this amount.

Pennsylvania: Engineering and inspection charges are 5.6% of the cost of construction, and administration, 1.4%, making a total of 7%.

Rhode Island: Plans and surveys are 2% of the cost of construction, engineering and inspection, 2%, and administration, 5%, making a total of 9%.

Virginia: Engineering and inspection charges are 5% of the cost of construction. Administrative charges are not given.

Wisconsin: All overhead charges including engineering and administration are 5% of the cost of construction. Inspection, however, is charged directly to construction.

It is interesting to compare these figures with those given for the California State Highway work published in April WESTERN ENGINEERING, by State highway commissioner Charles F. Stern. These were 4.41% for administration and 8.18% for surveys, and engineering and inspection during construction, a total of 12.59%. It is probable, however, that the difference between these figures and those given for several of the other States is largely a matter of bookkeeping.

Tamping a concrete pavement with a roller instead of by hand in the construction of a street at Ellenville, New York, is described by P. E. Clark in *Good Roads*. The roller used was a 3-in. pipe 16 ft. long and filled with dry sand to give it additional weight. The roller was run back and forth over the pavement and at times lifted clear of the concrete, carried back to the curb, and rolled toward the concrete last placed. This kept the excess water away from the curb and mixed it with the fresh concrete.

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Bids for Construction of System for Anderson-Cottonwood Irrigation District*

The Anderson-Cottonwood irrigation district comprises about 32,000 acres along the Sacramento river in the southern part of Shasta county and the northern part of Tehama county, California. The district was organized in 1915 and a bond issue of $480,000 was sold early in 1916. Plans for the system were prepared by H. H. Henderson, of Stockton, California. Bids for the work were opened on April 29.

The intake for the system is situated at Redding. The intake tunnel including portal, is 2480 ft. long and runs under part of the town. There is about 35 miles of main canal and a large number of laterals.

The following bids were received on the diversion dam and weir across the Sacramento river at the intake:

Porter Bros. Co	$36,500
Teichert & Ambrose	55,400
Blake Bros. Co	64,000
Ross Construction Co	64,000

The intake tunnel is to be 5 ft. wide at the bottom, and 9 ft. wide at the springing line with a semi-circular arch. The springing line is 6 ft. above the floor of the tunnel, making the total height 10 ft. 6 in. The tunnel will require a concrete lining. There is little information available regarding the character of the material to be encountered, which fact may perhaps account for the wide variation in the bids on this part of the work. The contract for the intake weir, tunnel and outlet portal was awarded to James Willison of Turlock, for $49,995. Mr. Willison recently completed a similar tunnel for the Oakdale irrigation district, which was described in the March number of WESTERN ENGINEERING. Other bidders were

Chadwick & Sykes, San Francisco	$58,884
Porter Bros. Co., Portland	66,208
Blake Bros. Co., San Francisco	69,000
Teichert & Ambrose, Sacramento	69,000

The portion of the main canal from station 24 + 80 to station 70 + 00 contained a large number of loose boulders, the rest of the main canal and all the laterals were almost entirely in common earth excavation. The portion of the main canal between station 24 + 80 and station 1060 + 00 was awarded to James Willison for between $0.12 and $0.13 per cu. yd. Some of the other bids were as follows:

Station 24 + 80 to station 70 + 00, 51,925 cubic yards, canal 40 and 45 ft. wide on bottom, banks, 7½ ft. high, and 10 ft. wide on top.

	Per cu. yd.
Porter Bros Co	$0.22
Maney Bros. & Co	0.50
Blake Bros. Co	$0.33
Chadwick & Sykes	0.175
James Fitzpatrick	0.45

Station 70 to station 650, 353,133 cu. yd., canal from 24 to 45 ft. wide on bottom, banks 7½ ft. high, and 8 to 10 ft. wide on top.

	Per cu. yd.
Porter Bros. Co	$0.14
Maney Bros. & Co	0.18
Blake Bros. Co	0.17
Chadwick & Sykes	0.175
James Fitzpatrick	0.25

Station 650 to station 1060, 227,433 cu. yd., canal from 20 to 24 ft. wide on bottom, banks 7.5 ft. high and 8 ft. wide on top.

	Per cu. yd.
Porter Bros. Co	$0.14
Maney Bros. & Co	0.18
Blake Bros. Co	0.16
Chadwick & Sykes	0.175
James Fitzpatrick	0.25

Station 1060 to station 1870, 183,743 cu. yd., canal from 20 down to 5 ft. wide on bottom, banks from 7.5 down to 5.5 ft. high, and from 8 down to 3 ft. wide on top.

	Per cu. yd.
Porter Bros. Co	$0.16
Maney Bros. & Co	0.18
Blake Bros. & Co	0.239
Hewitt & Felch	0.21
Chadwick & Sykes	0.18

All canals and laterals are to have banks with a 1 : 1 slope.

Laterals No. 3 to No. 19, canal 3 to 10 ft. wide on bottom, banks 2.5 to 6.5 ft. high and from 2 to 5 ft. wide on top.

	Per cu. yd.
Porter Bros. Co	$0.16
Hard Bros.	0.19

Laterals No. 3-1 to 3-2, canal 5 ft. wide on bottom, banks 5.5 ft. high and 3 ft. wide on top.

	Per cu. yd.
Porter Bros. Co	$0.16
T. H. Lynch and J. A. Maddox	0.18

Laterals No. 2 to 2-2, canal 3 ft. wide on bottom, banks 2.5 ft. high, and 2 ft. wide on top.

	Per cu. yd.
Porter Bros. Co	$0.16

Laterals No. 21 to 21-5, canal 5 to 10 ft. wide on bottom, banks 5.5 to 6.5 ft. high, and 3 to 5 ft. wide on top.

	Per cu. yd.
Porter Bros. Co	$0.16
Bland & Duncan	0.16
Hard Bros.	0.18
Chadwick & Sykes	0.18

*From data furnished by E. M. Downing, secretary for the Anderson-Cottonwood irrigation district, Anderson, California.

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	Per cu. yd.
Hewitt & Felch	0.16
Blake Bros. Co.	0.21
T. W. and George Harlan	0.225
T. H. Lynch and J. A. Maddox	0.17
W. C. Barber	0.27

Laterals 23 to 35-2, canal 5 ft. wide on bottom, banks 5.5 ft. high and 3 ft. wide on top.

	Per cu. yd.
Porter Bros. Co.	$0.16

Laterals No. 37 to 47, canal 3 to 5 ft. wide on bottom, banks 2.5 ft. high and 2 ft. wide on top.

	Per cu. yd.
Porter Bros. Co.	$0.16
Hewitt & Felch	0.18

The Churn Creek siphon was composed partly of 42-in. cast-iron pipe and partly of a 54-in. concrete conduit. The following bids were received:

Chadwick & Sykes	$30,000
Contra Costa Construction Co.	40,850
Ross Construction Co.	41,400
V. M. Price	46,800

A number of concrete siphons from 3 to 10 ft. in diameter are included in the project. The bids on these were as follows:

	Per lin ft., according to size		
Teichert & Ambrose	$3.52	to	$17.40
V. M. Price	5.50	to	25.00
Contra Costa Construction Co.	6.00	to	32.00
Ross Construction Co.	9.00	to	28.00

A number of wooden bridges carrying highways and private roads over the newly-constructed canals are included. in the project. These range in size between type 0, which is 14 ft. wide and 8 ft. long to type 11, which is 20 ft. wide and 61 ft. long.

Bids on type No. 0 were as follows:

William Stephens	$63.00
Ross Construction Co.	75.00
Chadwick & Sykes	75.00
Tieslau Bros.	78.95

Bids on type No. 11 were as follows:

Ross Construction Co.	$500
Chadwick & Sykes	600
Tieslau Bros.	634

Contract for all bridges was awarded to F. H. Neilson of Orland for $15,000. The itemized figures are not available.

There is to be a good deal of semi-circular metal flume on wooden trestles. The type No. 1 flume has a radius of 11½ in. The bids for furnishing this size of flume were as follows:

	Per lin. ft.
Western Pipe & Steel Co.	$0.40
California Corrugated Culvert Co.	0.45

The type No. 7 flume had a radius of 3 ft. 6 in. The bids were as follows:

	Per lin. ft.
Western Pipe & Steel Co.	$2.05
California Corrugated Culvert Co.	2.22

Following was the bid of Tieslau Bros. for the construction of the flume trestles:

Height above concrete piers, feet	Type No. 1 Per lin. ft.	Type No. 7 Per lin. ft.
4 to 7	$12.54	$23.36
7 to 12	13.94	25.00
12 to 18	15.54	27.12
18 to 24	18.56	31.04
24 to 30	21.34	34.48

There were a number of drops, gates, and other structures, which were necessarily of varying design. Except the two contracts to James Willison and the contract to F. H. Neilson, already noted, all bids on construction were rejected and new bids were to be opened on May 29.

For furnishing about 13,000 bbl. of portland cement, the following bids were received:

	Per bbl.
McCarley & Smith Mercantile Co.	$2.56
McCormick-Saeltzer Co.	2.56
J. F. Bedford Co.	2.97
Henry Cowell Lime & Cement Co.	2.97
W. L. Rose & Co.	2.97
D. B. Nathan	3.00

Contract was awarded to McCarley & Smith Mercantile Company.

On furnishing 36 to 42-in. cast-iron pipe, McCarley & Smith Mercantile Co. bid $50 to $61 per ton.

The use of sand-cement during the construction of the Elephant Butte dam on the Rio Grande project of the United States Reclamation Service is described by R. R. Coghlan in the *Reclamation Record*. Sand-cement is a definite mechanical mixture of portland cement and a silicious material, which, on the addition of water, develops chemical properties but little, if any, inferior to those of portland cement when used in mass concrete. Its manufacture involves no chemical reactions. All that is required is the reduction of the silicious material to a size small enough to permit its being completely mixed with the portland cement. The two materials are then ground together to an impalpable powder, smaller in grain than the portland cement itself. Sand-cement was used in the mass concrete at the Elephant Butte dam. The plant cost $70,000, and has manufactured 621,550 bbl. of sand-cement, with an average composition of 52% portland cement and 48% sandstone. It is estimated that a saving of $250,000 has been effected by the use of sand-cement instead of portland cement.

The use of reinforcement in a concrete pavement laid on a quicksand subgrade was described by W. C. Hammatt at the Pan-American Road Congress. Concrete made with rather fine aggregate was placed at the bottom and struck off to a thickness of about one inch. The steel reinforcement was placed on this concrete and worked down into it, the additional concrete being placed on top. On this account accurate placing of the reinforcement was not necessary. About 0.4 lb. of steel was used per sq. ft. of pavement. The cost of reinforcement was $0.01 per sq. ft., and the additional cost of placing, $0.01 per sq. ft., making $0.02 per sq. ft. for the total additional cost of reinforcement.

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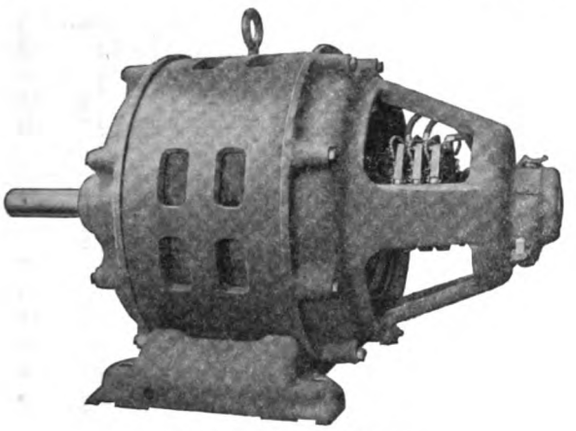
Industrial Progress

WESTINGHOUSE SLIP-RING INDUCTION-MOTOR

A new slip-ring induction-motor, type CI, for severe, intermittent, varying speed service has just been developed by the Westinghouse Electric & Manufacturing Co., of East Pittsburg, Pennsylvania. These motors are especially designed for heavy duty on cranes, hoists, draw-bridges, roller-lift bridges, railway turn-tables, transfer-tables, and similar applications. They are furnished in sizes from 1½ to 200 hp. for operation



SLIP-RING INDUCTION-MOTOR.

on two and three-phase, 220 and 440-volt, 25 and 60-cycle circuits.

The frames of the smaller sizes are made up of steel laminations riveted between forged steel and shields; in the larger sizes the frames are made of rolled open-hearth steel. The brackets are of cast-iron with reinforcing ribs to insure rigidity and perfect alignment of the bearings at all times. The bearings are self-oiling and of the oil-ring type. The steel brush-holders are supported by and insulated from the bracket, which is open to permit easy inspection and renewal of the brushes. The rotor is of small diameter, thus reducing the fly-wheel effect. The shaft is of axle-steel and can be removed from the rotor without disturbing the windings. The running torque of those motors is the maximum obtainable and the starting and pull-out torques exceed twice full-load torque.

THE KINNEY ROTATING-PLUNGER PUMP

The handling of viscous materials is a problem that calls for specially designed pumping machinery. For this work the Kinney Manufacturing Co., of Boston, Massachusetts, has developed a rotating-plunger pump. The main features of the pump are two eccentric cams, operating two rotating plungers inside the pump casing. There are no valves. At the U. S. Navy Fuel-Oil testing plant at League Island, Pennsylvania, a pump which had been in use for two years with pressure up to 270 lb. was measured with a micrometer. No sign of wear could be observed. These pumps are specified on the battleships now being constructed.

Book Reviews

RULES FOR CONDUCTING PERFORMANCE TESTS OF POWER PLANT APPARATUS. P. 209. Ill., index. The American Society of Mechanical Engineers, New York.

The Committee appointed in April 1909 by the American Society of Mechanical Engineers to revise the testing codes of the Society relative to power-plant apparatus has completed its work. The rules cover tests of boilers, reciprocating steam-engines, steam-turbines, pumping machinery, compressors, blowers, and fans, complete steam-power plants, locomotives, gas-producers, gas and oil-engines, and water-wheels. Needless to state, the Committee has done its work in a thorough and careful manner, and the resulting volume will be indispensable to anyone having to do with power-plant testing.

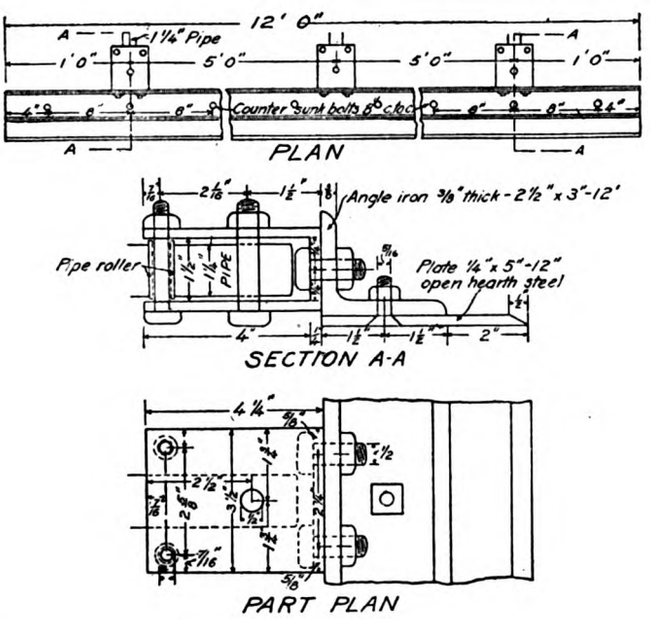
GOOD ROADS YEAR BOOK. The American Highway Association, Washington, D. C. P. 432. Ill., index. Price, $1.

The subject matter of the present year book of the American Highway Association is similar to that of previous years, but the arrangement of the book is greatly improved. This improvement in arrangement has extended to the table of contents and the index. Part I contains data regarding road improvements and the laws concerning them in the various States. Part II contains similar information regarding foreign countries, a discussion of the different types of roads, a summary of State-highway specifications, and data on road maintenance and similar subjects. Part III discusses highway bonds, particular attention being given to the mathematical theory of amortization and interest. It also contains a bibliography, lists of manufacturers of highway materials, highway associations, and a glossary of technical terms used in highway construction and maintenance. The book will be of value to anyone interested in highway work.

Hints on Practice

CANAL-SLOPE TRIMMER

The accompanying drawing shows a device which, according to the *Reclamation Record*, is used for preparing canal slopes for concrete lining on the Carlsbad, New Mexico, project of



SKETCH OF TRIMMER.

the U. S. Reclamation Service. The trimmer is operated by men on the canal bank, using the 1¼-in. pipe as a push-rod and lever, the trimmer being slid and worked down a track consisting of 1¼-in. tees set 10 ft. apart and true to slope. A considerable saving in labor is effected over the common method of trimming with shovels.

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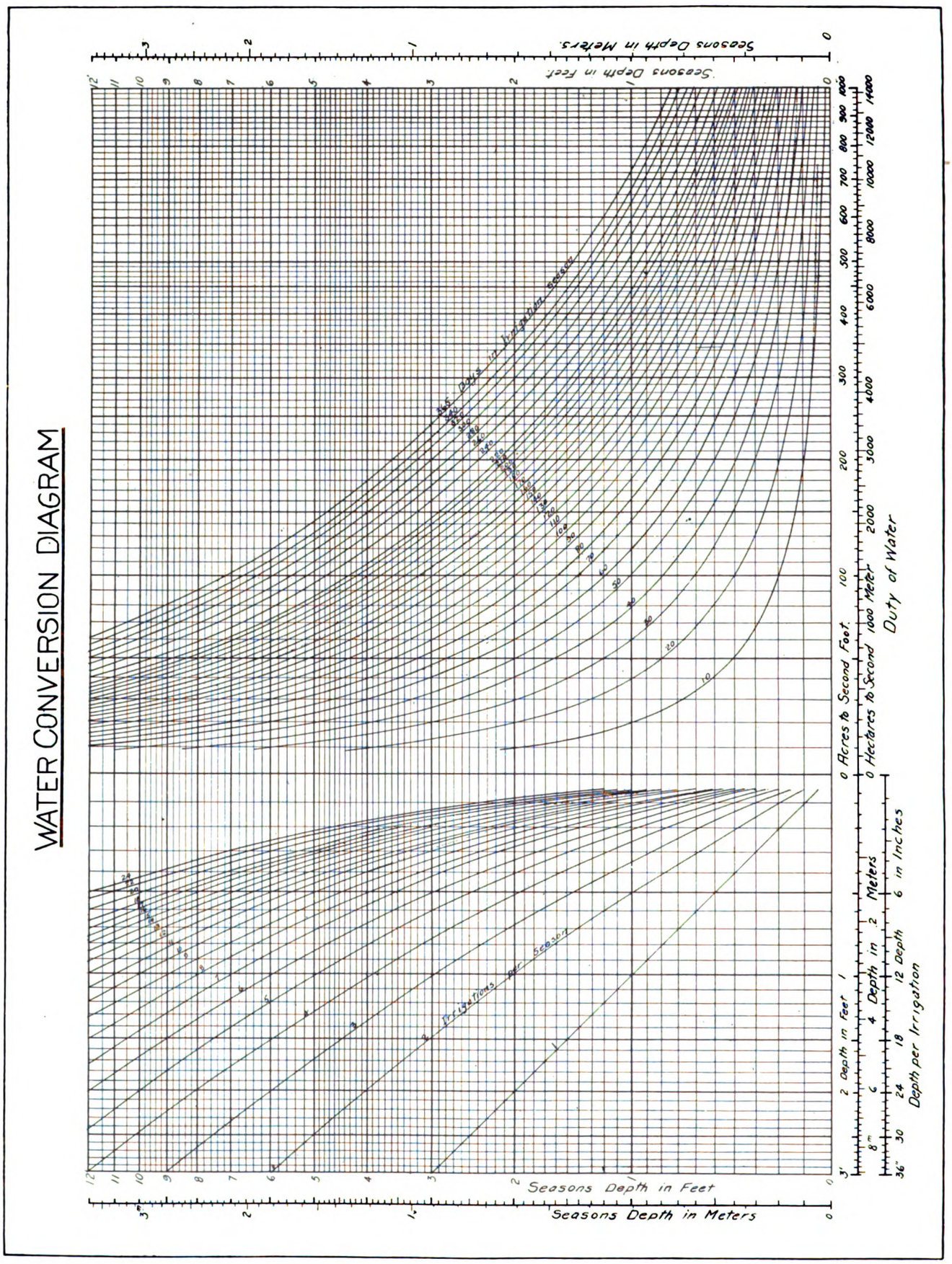

WATER CONVERSION DIAGRAM.

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Engineers' Note Book

WATER CONVERSION DIAGRAM

By CHARLES KIRBY FOX and CHARLES M. STOKES*

The accompanying diagram can be used for the quick solution of a number of irrigation problems, such as: given a depth of water of 9 in. per irrigation and four irrigations per season, required the total depth of water per season. At the left-hand side of the diagram follow vertically to the inclined line of four irrigations per season, thence horizontally to 3 ft. in the left-hand margin. Also: given a depth of water of 3 ft. for the season and 150 days in the irrigating season, required the duty. From the right-hand margin, follow horizontally to the curve for 150 days in the irrigating season, thence vertically to 100 acres per second-foot at the bottom of the diagram. Other uses for the diagram will suggest themselves to the irrigation engineer.

New Publications

THE CAISSON AS A NEW ELEMENT IN CONCRETE DAM CONSTRUCTION. By O. G. Aichel. P. 32. Ill. Spon & Chamberlain, New York. Describes a method of constructing a concrete dam across a large perennial stream by using a caisson instead of employing a diversion channel. The application of this method to the construction of a proposed dam across the Columbia river at Five Mile Rapids is discussed.

AUTOGENOUS WELDING OF 'NATIONAL' PIPE. Bulletin No. 26. The National Tube Co., Pittsburg, Pennsylvania. P. 52. Ill. This bulletin discusses methods of welding pipe as a substitute for screw, flange, and other connections. Electric, blowpipe, and thermit welding are all considered, but most of the space is devoted to the oxy-acetylene process of blowpipe welding. Valuable cost data for this process are included.

Engineering Societies

IDAHO SOCIETY OF ENGINEERS. Ira F. Schaffner, secretary, Boise.

Los Angeles Section of AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Ford W. Harris, secretary, 1029 Higgins building.

Los Angeles Section of AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Edward Woodbury, secretary, 255 East 3rd street.

OREGON SOCIETY OF ENGINEERS. Orrin E. Stanley, secretary, room 409, City Hall, Portland.

Portland Section, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Paul Lebenbaum, secretary, 45 Union Depot.

Portland Association of Members of AMERICAN SOCIETY OF CIVIL ENGINEERS. Charles McGonigle, president, care Western Sheet Metal Works.

San Francisco Association of Members of AMERICAN SOCIETY OF CIVIL ENGINEERS. E. T. Thurston, Jr., secretary, Mechanics Institute building.

San Francisco Section of AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Carl F. Braun, secretary, Hooker & Lent building.

San Francisco Section of AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. A. G. Jones, secretary, 811 Rialto building.

Southern California Association of Members of AMERICAN SOCIETY OF CIVIL ENGINEERS. W. K. Barnard, secretary, 701 Central building, Los Angeles.

The annual meeting of the San Francisco Section of the AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS was held at the Engineers' Club on May 26. The paper for the evening was 'Laying Power Cables across San Francisco Bay,' by J. A. Koontz and B. P. Cornell.

At the ENGINEERS' CLUB luncheon talk on May 11, W. W. Campbell, director of the Lick Observatory, spoke on 'The Stellar System.' On May 25, the subject was 'International Law,' and the speaker, E. G. Elliott.

A joint meeting on military preparedness was held under the auspices of the local sections of the five national engineering societies, at Native Sons Hall, San Francisco, May 2. Captain Richard Park spoke on 'Methods by which Civilian Engineers Can Prepare Themselves to Assist the Engineer Corps of the U. S. Army in Case of War.' Captain John Murphy spoke of 'The Work of the Military Training Camps.' A. H. Babcock gave an 'Outline of the Work of the Organization for Industrial Preparedness of the Naval Consulting Board.'

At a luncheon at the Engineers' Club of San Francisco, given under the auspices of the Engineer Corps of California, Joseph D. Smedberg sketched 'The Object, Policy, and Membership of the Engineer Corps of California,' General W. L. Sibert gave 'Some Experiences with Engineer Troops in the Field,' Captain Richard Park spoke of 'Study and Drill Schedules for the Engineer Corps of California,' and Lieutenant Colonel Thomas H. Rees spoke of 'The Relation of the Engineer Corps of California to the Engineer Corps and other Technical Branches of the Army.'

Coming Conventions

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Semi-annual meeting, Cleveland, Ohio, June 14-17. L. C. Olsen, secretary, Cooper Union, New York.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Annual meeting, Atlantic City, New Jersey, June 19-21. J. W. Taylor, secretary, Karpen building, Chicago.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting Pittsburg, June 27-30. Charles Warren Hunt, secretary, 220 West 57th street, New York.

AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting Atlantic City, New Jersey, June 27-July 1. Edgar Marburg, secretary, University of Pennsylvania, Philadelphia.

AMERICAN WATER-WORKS ASSOCIATION. Annual Convention, New York, June 5-9. J. M. Diven, secretary, 47 State street, Troy, New York.

INTERMOUNTAIN GOOD ROADS ASSOCIATION. Sixth annual convention, Ogden, Utah, June 13-14. Thomas H. Burton, secretary, Nephi, Utah.

MASTER CAR BUILDERS' ASSOCIATION. Annual meeting, Atlantic City, New Jersey, June 14-16. J. W. Taylor, secretary, Karpen building, Chicago.

NATIONAL CONFERENCE ON CITY PLANNING. Annual convention, Cleveland, June 5-7. Flavel Shurtleff, secretary, 19 Congress street, Boston

NATIONAL GAS ENGINE ASSOCIATION. Annual convention, Chicago, June 27-29. H. R. Brate, secretary, Lakemount, New York.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION. Annual convention, Atlantic City, New Jersey, June 14-21. J. D. Connell, secretary, 2136 Oliver building, Pittsburg, Pennsylvania.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Annual meeting, Charlottesville, Virginia, June 19-22. F. L. Bishop, secretary, University of Pittsburgh, Pittsburgh, Pennsylvania.

SOCIETY OF RAILWAY CLUB SECRETARIES. Annual meeting, Atlantic City, New Jersey, June 16-17. H. D. Vought, secretary, 95 Liberty street, New York.

*Pomona, California.

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Personal

C. D. MARTIN has been re-appointed city engineer of Merced, California.

ROBERT L. READING has been appointed city engineer of Redding, California.

PAUL E. KRESSLEY has been re-appointed city engineer of Beaumont, California.

F. J. MUELLER has been appointed city engineer and superintendent of streets of Corona, California.

SYDNEY JONES has been appointed city engineer of Hayward, California, succeeding R. H. GOODWIN, who resigned.

W. C. WATTLES has been appointed city engineer of Tropico, California, succeeding GEORGE N. ADAMS, who resigned.

ROBERT H. GOODWIN, formerly city engineer of Hayward has been appointed city engineer of San Leandro, California.

WYNN MEREDITH has resigned from the electricity commission of the city of Alameda because of the pressure of other business.

WILLIAM MULHOLLAND, chief engineer of the Los Angeles Aqueduct, has been engaged as consulting engineer on flood-control by the city of Dayton, Ohio.

GEORGE S. NICKERSON has been appointed chief engineer and general manager for the North Fork Ditch Co., with headquarters at Sacramento, California.

G. E. HILL, for several years deputy city engineer of South Pasadena, California, has been appointed city engineer, succeeding JOHN MACMILLAN, who resigned.

S. H. FINLEY, chief engineer for the Orange County, California, Highway Commission, has been appointed engineer for the newly-incorporated town of Seal Beach.

FRANK ADAMS, for several years irrigation engineer for the U. S. Department of Agriculture, has been appointed professor of irrigation investigations at the University of California.

A. E. CHANDLER has been elected chairman, and ELMER L. SISSON, secretary of the California State Irrigation Board. The other members of the Board are D. W. ROSS and W. P. BOONE.

The firm of TOWNSEND, GRAHAM, & HARRIS, patent lawyers, of Los Angeles, has dissolved. The practice will be continued by F. L. A. GRAHAM and FORD W. HARRIS, under the name of Graham & Harris.

FRANK STRONG has been appointed division engineer of maintenance-of-way for the San Pedro, Los Angeles & Salt Lake railroad, with headquarters at Salt Lake City. This road is now known as 'The Salt Lake Route.'

LYNN CRANDALL, formerly assistant engineer for the U. S. Geological Survey, with headquarters at Salt Lake City, has resigned to become chief hydrographer for the Twin Falls North Side Land & Water Co. at Jerome, Idaho.

FRANCIS T. CROWE, engineer for the United States Reclamation Service, who has been in charge of drainage work on the Boise project, has returned to Jackson Lake, Wyoming, to work on the enlargement of the dam at that place.

Obituary

WILLIAM H. HOLCOMB, railroad and mining engineer, died May 10 at his home in Eureka, California.

JAMES JEROME HILL, builder and for many years president of the Great Northern Railroad, died May 29 at his home in St. Paul, Minnesota.

JOHN A. BUNTING, pioneer oil operator in the Coalinga field and founder of the Bunting Iron Works, died May 2 at his home in Centerville, California.

FRANK G. JANNEY, manager of the Utah Copper Co. and an associate of D. C. Jackling in mining enterprises, died in Los Angeles May 12, following an operation for appendicitis.

FRED T. PERRIS, chief engineer of the Atchison, Topeka & Santa Fe Railroad during the construction of its first lines in southern California, died May 12 at his home in San Bernardino, California.

JOHN EDSON SWEET, inventor of the straight-line engine, past president of the American Society of Mechanical Engineers, and at one time professor of practical mechanics at Cornell University, died May 8 at his home in Syracuse, New York.

ELMER L. CORTHELL, president of the American Society of Civil Engineers, died May 16 at Albany, New York. His wide engineering experience included railroad work in the Middle West, river improvement on the Mississippi, and finally harbor construction in many countries, mainly in South America.

DAVID WEST CUNNINGHAM died at his home near Los Angeles May 12. Mr. Cunningham retired from the practice of civil engineering some years ago. He had been concerned in the construction of a number of waterworks in the Eastern States and later built the first railroad over the Andes mountains for the Chilean Government.

Commercial Paragraphs

O. E. Thomas has been appointed district sales manager for the TERRY STEAM TURBINE Co. with headquarters at Los Angeles. His territory consists of Arizona and southern portions of California and Nevada.

The GOOD ROADS MACHINERY Co., manufacturers of road-making and contractors machinery has opened an office and warehouse in San Francisco and also a branch in Los Angeles. The San Francisco office at 1017 Hearst building, is in charge of G. F. Monfort.

The KINNEY MANUFACTURING Co., of Boston, Massachusetts, making and handling rotating-plunger pumps and asphalt distributers, has opened a California branch office at 316 Rialto building, San Francisco. R. S. Danforth is manager. The company recently sold a 12-in. pump to the Shell Oil Co. for use at their new loading station at the foot of Leavenworth street. The pump is equipped with a General Electric motor and Morse silent chain-drive. The Shell company has ordered 20 steam-driven Kinney pumps for use at various points. The Kinney company has also sold a pump to the Associated Pipe Line Company.

Catalogues Received

MEESECO GAS-ENGINE CLUTCH. Meese & Gottfried Co., San Francisco. P. 16. Ill. Describes a new kind of friction clutch.

ROTHMOTORS. Bulletin No. 212. Roth Bros. & Co., Chicago. P. 12. Ill. Describes the type C and type IX alternating-current motors manufactured by the company.

OSGOOD 18 AS APPLIED TO TRENCH EXCAVATING. The Osgood Co., Marion, Ohio. P. 12. Ill. Describes the Osgood 18 steam-shovel, with special attention to its use in digging trenches.

THE SULLIVAN 'DR-6' MOUNTED WATER HAMMER DRILL. Bulletin No. 70-C. The Sullivan Machinery Co., Chicago. P. 16. Describes a hammer drill with water jet that may be mounted on a tripod, column, or bar.

THE 'P. & H.' PIPE LINE EXCAVATOR. Bulletin No. IX. Pawling & Harnischfeger Co., Milwaukee, Wisconsin. P. 20. Ill. Describes the trench excavators of the wheel type that are manufactured by the company.

OIL-FILTERS. The Richard-Phenix Co., Milwaukee, Wisconsin. P. 24. Ill. Describes the oil-filters manufactured by the company. The standard sizes have capacities ranging from 1 to 800 gallons per hour and special filters are made with a capacity up to 50,000 gallons per hour.

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Western Engineering

WEEKLY NEWS BULLETIN

WESTERN ENGINEERING *with* WEEKLY NEWS BULLETIN $4.50 per Year

SAN FRANCISCO, JUNE 5, 1916

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CONSTRUCTION NEWS

STREET AND ROAD WORK

Alameda, Cal.—All bids for construction of pavement on Central avenue have been rejected. This is the second time this has happened. New specifications will b prepared and work will be re-advertised.

Bakersfield, Cal.—Contract for improvement of several streets has been awarded to F. W. Nighbert at $0.019 per sq. ft., for grading and tamping and $0.65 per foot for laying 5⅜-in. steel pipe for drains.

Bellingham, Wash.—Contract for construction of asphalt pavement on Alabama street has been awarded to J. Lich for $13,929.80.

Eureka, Cal.—Bids will be received until June 13 for grading and construction of concrete pavement on ½ mile of highway in road district No. 4.

Fairfax, Cal.—County will construct 1½ miles of oil macadam highway. Estimated cost is $2500. Work will be under the direction of supervisor Michael Burke.

Fresno, Cal.—Contract for grading and construction of curbs and macadam pavement on Poplar avenue has been awarded to Thompson Bros. for $1786.

Los Angeles, Cal.—Board of Public Works will receive bids until June 5 for the following street work: grading, oiling, concrete curbs, sidewalks, and gutters on Middlebury street and on Vestal avenue; concrete pavement, curbs, and sidewalks, and vitrified pipe sanitary sewer on Sunset drive; grading, oiling, concrete curbs, sidewalks, and gutters, and vitrified pipe sewers on Marathon street and on Meridian street; asphalt pavement, concrete curbs, gutters, and sidewalks on San Marino street.

Bids will be received until June 5 by F. G. Dessery, engineer Kalorama Land Co., 514 Central Bdg., for grading and oiling 19,500 sq. ft. of street.

Contract for improvement of Bunker Hill avenue has been awarded to Bryant & Austin, Inc., 1650 Compton avenue, for $7173.58.

Contract for improving Kenmore avenue has been awarded to George H. Oswald, 405 O. T. Johnson Bdg., for $4531.41.

Contract for improvement of Sacramento street has been awarded to George H. Oswald for $11,959.35.

Contract for improving Franklin avenue has been awarded to William Liddington, 420 East 60th street, for $5168.68.

Montesano, Wash.—County Commissioners will receive bids until June 19 for construction of permanent highway No. 13 and for clearing, grading, and graveling part of Wynooche Valley highway.

Contract for graveling part of Wynooche-Wishkah highway has been awarded to Standard Transfer Company.

Napa, Cal.—Contract for improvement of Seymour street has been awarded to F. A. Burge for $1724.88. George E. Errington bid $1725.87.

H. C. Mullett was low bidder for improvement of Laurel street at $2372.65. George E. Errington bid $2631.72.

Niles, Cal.—Contract for construction of concrete underpass under tracks of Southern Pacific railroad west of Niles has been awarded to Tieslau Bros. for $19,389.

Oakland, Cal.—Bids will be received until noon, June 15, by L. W. Cummings, city clerk, for grading and construction of redwood curbs, concrete gutters and sidewalks, and oil macadam pavement for four blocks on 45th avenue.

Ontario, Cal.—Bids will be received until 7:30 p.m., June 5, by city clerk, for grading, oiling, and graveling, and construction of concrete curbs and gutters on Campus avenue. B. B. Mann is city engineer.

Pomona, Cal.—Contract for grading and construction of oil macadam pavement on Park avenue has been awarded to Lon Fleming & Son for $2200.

Raymond, Wash.—Contract for construction of a portion of the Sound Bend-Raymond boulevard has been awarded to John Cheek for $3981.

Redondo Beach, Cal.—Contract for grading and construction of concrete pavement, sidewalks, and curbs on Lucia avenue has been awarded to California-Arizona Construction Co., 1700 East Washington street, Los Angeles, for $28,809.92.

Sacramento, Cal.—Clark & Henery Construction Co. submitted the lowest bid for street improvement work ever submitted. Their bid was 9¼c. per sq. ft. for the improvement of 33rd street, from Y street to Cypress avenue. According to Commissioner Burke the low bids are the result of a fight that is being waged between the contractors, due to the entry of Teichert & Son into the stret paving business.

Contract for improvement of Riverside avenue has been awarded to McGillivray Construction Company.

San Francisco, Cal.—Contract for improving Morse street has been awarded to Karl Ehrhart, 1137 Bush street, for $8986.

San Gabriel, Cal.—Contract for construction of macadam pavement and concrete curbs on Shorb highway has been awarded to M.-R. Co., Hollingsworth Bdg., Los Angeles, for $8554.47.

Santa Monica, Cal.—All bids for grading and paving several alleys have been rejected and work will be re-advertised.

Seattle, Wash.—Board of Public Works will receive bids until June 9 for grading Terrace and other streets.

Bids will be received until June 19 by County Commissioners for grading and graveling 6.7 miles of highway between Black Diamond and Maple Valley. Estimated cost is $55,000.

Spirit Lake, Ida.—Panhandle highway district has been organized. Plans include construction of 2½ miles of highway.

Spokane, Wash.—Contract for paving Apple way has been awarded to Spokane Bitu-Mass Paving Co. for $26,151.

Contract for paving Mead highway has been awarded to Standard Asphalt Paving Co. for $12,961.

Tacoma, Wash.—All bids for construction of 2½ miles of Pacific highway from Dupont south have been rejected.

Contract for construction of bitu-crete pavement on six miles of Mount Tacoma highway has been awarded to H. J. Kaiser, Everett, for $95,970.

Terry, Mont.—Bids will be received until June 6 by W. A

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Mackin, county surveyor, for grading 4½ miles of highway and for graveling 5 miles of highway.

Upland, Cal.—Bids will be received until 7:30 p.m., June 26, by C. P. Fuller, city clerk, for grading, oiling, and construction of curbs on Ruedy street.

Vallejo, Cal.—Call for bids will be issued about June 16 for street improvement in northwest paving district. Work includes 24,414 cu. yd. excavation, 126 cu. yd. sand fill; 15,165 ft. concrete curb, 576 ft. curb armor; 258,144 sq. ft. 4-in. concrete pavement, with 1-in. asphaltic concrete wearing surface; 12,000 sq. ft. brick pavement on 2½-in. concrete base; 40 cu. yd. reinforced concrete retaining wall; 400 lin. ft. reinforced concrete guard-rail; 7376 sq. ft. sidewalk; 1182 corrugated iron culverts; 483 ft. 4-in. lateral sewers.

Venice, Cal.—Contract for grading and construction of asphaltic concrete pavement on several streets has been awarded to Braun, Bryant & Austin, Santa Monica, for $2688.

Ventura, Cal.—Contract for grading ¾ mile of Santa Ana highway has been awarded to C. H. Hudson, Trust & Savings Bdg., Los Angeles, for $4871.

Washtuena, Wash.—Contract for building four miles of permanent highway has been awarded to W. H. Murmade, Prosser, for $17,000.

SEWERS AND DRAINAGE

Anaconda, Mont.—Bids will be received until 8 p.m., June 5, by M. J. Kelly, city clerk, for construction of storm-water drains and 15,000 sq. yd. of pavement in district No. 84.

Hemet, Cal.—City clerk will receive bids until 7 p.m., June 5, for construction of additional spetic tanks at the city sewer farm.

Los Angeles, Cal.—Board of Public Works will receive bids until June 5 for construction of vitrified-pipe sanitary sewer on 14th street.

Oakland, Cal.—Bids will be received until noon, June 15, by L. W.Cummings, city clerk, for construction of 543 ft. of 8-in. vitrified-pipe sewer on Harvey avenue and 200 ft. of 8-in. sewer on D street.

Redondo Beach, Cal.—Bids will be received until 8 p.m., June 12, by C. C. Mangold, city clerk, for furnishing ten carloads of standard sewer pipe, sizes ranging from 4 to 18 in. diameter.

Salinas, Cal.—Owners of about 4000 acres of swamp land in this vicinity are considering formation of reclamation district. Estimated cost of works is $65,000. L. G. Hare and C. F. Lacey are interested.

Salt Lake City, Utah—Bids will be received until June 22 by Gordon Snow, city recorder, for construction of sewer extension No. 297. Plans from city engineer upon deposit of $5.

San Francisco, Cal.—Contract for construction of sewer in Oakvale avenue has been awarded to Karl Ehrhart, 1137 Bush street, for $19,517.

Seattle, Wash.—Board of Public Works will receive bids until June 9 for construction of sewers on Mead and other streets.

Stockton, Cal.—City of Stockton will spend $100,000 on new sewage disposal plant under bond issue voted last year. Two disposal plants will be erected.

BRIDGES AND CULVERTS

Fallon, Nev.—Bids will be received by A. E. Wilson, clerk, for construction of bridge across the Carson river.

Modesto, Cal.—New bids will be received until June 13 for construction of large reinforced concrete bridge over Tuolumne river near Modesto. Leonard & Day, Rialto Bdg., San Francisco, are engineers.

Phoenix, Ariz.—Contract for construction of 96-ft. steel bridge over Hassayampa river has been awarded to Midland Bridge & Iron Co. for $2732.

Renton, Wash.—Bids will be received until June 6 by G. Bates, city clerk, for construction of 20-ft. pile-trestle highway 1820 ft. long. Plans from city clerk upon deposit of $2.

Salt Lake City, Utah.—Salt Lake Route will construct large concrete arch, 93 ft. long, 23 ft. high, extending 18 ft. below the stream bed, and capable of sustaining 73,680 tons. Estimated cost is $60,000. Arthur Maguire is chief engineer.

San Bernardino, Cal.—Election has been called for July 25 to vote on bond issue of $140,500; $44,000 for steel bridges, $40,000 for pavement of storm-water drains, $20,000 for street repairs, $17,000 for fire protection, and the remainder for levees.

Santa Cruz, Cal.—Following bids were received for the erection of a steel bridge over Rodeo Gulch on Soquel road: Tieslau Bros., $15,400; C. E. Cotton, $15,841; McCray & Layaz, $15,943; Nelson Mosher, $16,498; Mesmer & Rice, $16,600; F. F. Moore, $16,795; Midland Bridge Co., $17,480; W. L. Gilhan & Son, $18,730; Golden Gate Iron Works, $19,374. Contract has been awarded to Tieslau Bros., San Francisco.

IRRIGATION AND WATER SUPPLY

Aberdeen, Wash.—Bids will be received until 5 p.m., June 7, by P. F. Clark, city clerk, for furnishing 150 ft. of 36-in. lap-welded pipe; 715 ft. of 26-in. pipe; 330 ft. of 16-in. pipe; and 2610 ft. of 16-in. wood-stave pipe.

Anderson, Cal.—Directors of Anderson-Cottonwood Irrigation District have awarded contract to Western Pipe & Steel Co., 444 Market stret, San Francisco, for furnishing metal flumes for $20,000.

James Willison, Turlock, who is now at work on the tunnel and upper part of the main canal for the Anderson-Cottonwood irrigation district, has been awarded the following additional contracts: lower part of main canal, 183,749 cu. yd. at $0.135; laterals No. 1 to 19, 49,000 cu. yd. at $0.13; lateral No. 21, 116,000 cu. yd. at $0.11; laterals No. 33 to 47, $3275 in all.

Contract for construction of Churn Creek laterals has been awarded to Frank C. McIntire, 1023 South San Joaquin street, Stockton, for $0.129 per cu. yd., or $14,448 in all.

Bids on construction of Churn Creek siphon have been taken under advisement.

Contract for construction of fences for Anderson-Cottonwood irrigation system has been awarded to F. H. Neilson, Orland, for about $2000.

Canby, Ore.—Bond issue of $18,000 for purchase of private water-system has been voted.

Guerneyville, Cal.—Northwestern Pacific Railroad has agreed to donate toward the expense of constructing a permanent dam and engineers will be sent to meet the local citizens committee.

Lemoore, Cal.—Election will be held June 10 to vote on the question of forming an irrigation district to be known as Stratford Irrigation District.

Los Angeles, Cal.—A bill appropriating $1,080,000 for Los Angeles harbor has passed the Senate as well as an appropriation of $220,000 for San Diego harbor. A dam will be built at the Los Angeles harbor and at San Diego the channel will be widened and deepened.

Contract for furnishing and laying cast-iron pipe for Los Angeles County Water Works district No. 1 has been awarded to Municipal & Industrial Equipment Co., 715 Story Bdg., for $26,000.

Modesto, Cal.—Contract for construction of dam No. 1 of the Dallas reservoir in the Modesto Irrigation District has been awarded to Tibbitts Pacific Co. for $82,487.50. Other bidders were: Ross Construction Co., $122,892.50; and Blake Bros Co., $81,700; the latter being thrown out on account of irregularities.

North Yakima, Wash.—Plans are being prepared for diversion dam on Yakima river at intake of Wapato canal and for reconstruction of present distributing system to cover 120,000 cres on Wapato project. Total estimated cost is $3,000,000. L. M. Holt is superintendent of irrigation for Yakima reservation.

Oakdale, Cal.—Board of Directors of Oakdale irrigation district has rescinded contract with James Willison for construction of Young lateral.

Olympia, Wash.—Following bids were received by the State Board of Control for the construction of a reservoir at the Washington Veterans Home, Port Orchard: A. W. Tweeden, Tacoma, $3550; W. E. Herbert, Seattle, $3700; Franklin Engineering Co., Seattle, $4020; J. A. Peabody, Bremerton, $4100; and Fred Clark, Port Orchard, $4236.

Paradise, Cal.—Paradise irrigation district is in the market for a gasoline engine and pump to work against a head of 125 ft. Plant will be used for excavating to bedrock by hydraulic methods the site of a masonry dam 125 ft. high and with a total length of 1100 ft. Work will take about two months. District would prefer to rent plant or to buy it second-hand. I. E. Goodner is engineer.

Sacramento, Cal.—Following were the bids received for the construction of the Sacramento River weir, proposal B was for the weir complete, proposal C was for the weir leaving out the highway bridge and supports: Teichert & Ambrose, B $336,640, C $225,780; McLeran & Peterson, B $348,825, C $224,225; H. S. Williams, B $357,063, C $212,390; Tibbitts Pacific Co., B $363,743, C $244,429; Ross Construction Co., B $373,395, C $243,935. All bids were rejected and work will be re-advertised.

Santa Fe, N. M.—W. G. Kelly, of the Kansas City bond buying firm of Kelly & Kelly, states that the sale of $325,000 worth of bonds issued by the Antelope Valley irrigation district, in Colfax county, will be consummated and the money will be available in about sixty days.

Santa Monica, Cal.—Bond issue of about $600,000 for purchase of property of private water companies has been voted.

Vale, Ore.—Irrigation district has been organized in Malheur

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valley. Plans include construction of reservoir containing 200,000 acre-feet.

Washington, D. C.—Contract for construction of first unit of Frannie division, Shoshone project, Wyoming, has been awarded to Security Bridge Co., Minneapolis, Minn., for $15,735.96. Work includes 4700 cu. yd. excavation, 580 cu. yd. concrete, 50,000 lb. reinforcing steel, 2000 ft. of drain pipe, and 20,000 ft. B.M. of lumber in structures.

Yreka, Cal.—Charles J. Laird, of Mount Dome section of Buttel valley, Siskiyou county, has applied to State Water Commission for permission to appropriate five second-feet of water of Lower Klamath lake to irrigate 200 acres of land. Water will be raised by pumping to a height of 22 feet. Estimated cost is $4000.

LIGHT, HEAT, AND POWER

Bakersfield, Cal.—Construction of ornamental lighting system in business district is proposed. Estimated cost is $28,310.

Berkeley, Cal.—Bids will be received until 9 a.m., June 9, at office of comptroller, University of California, for furnishing mechanical equipment for university power-plant. Plans from comptroller upon deposit of $10.

Pocatello, Ida.—Ornamental lighting system, embracing a large part of the business and residential districts of the city, is proposed. Estimated cost is $70,799.06.

BUILDING CONSTRUCTION

Anaheim, Cal.—Election has been called for June 13 to vote on bond issue of $35,000 for construction of school building.

Baker, Ore.—Bids will be received until June 12 by W. S. Bowers, school clerk, for the construction of a high school building for school district No. 5, Baker county. Separate bids are desired for the following: General contract, heating and ventilating, plumbing, wiring and electrical work.

Chico, Cal.—Contract for construction of a natatorium at the Chico State normal school has been awarded to E. D. Sharp.

Concord, Cal.—Marshall Soto and trustees Jackworth and Rosa have been appointed as a committee to secure bids for the construction of a jail building.

Fort Huachuca, Ariz.—Contract for construction of buildings at fort has been awarded to Kelly & Beahis, Leavenworth, Kansas, for $91,000.

Glendive, Mont.—Bond issue of $65,000 for construction of filtration plant has been voted.

Hayward, Cal.—Bond issue for construction of school buildings has been defeated.

Los Angeles, Cal.—Cresmer Mfg. Co. of Riverside, were low bidders at $119,500 for the construction of a graduate school of tropical agriculture at Citrus experiment station for the University of California.

Manteca, Cal.—C. L. Six will construct $15,000 brick building. Franklyn Warner, San Joaquin Bdg., Stockton, is architect.

Martinez, Cal.—Contract for construction of Carnegie library at Walnut Creek has been awarded to C. R. Hook for $2550.

Marysville, Cal.—Election has been called for June 28 to vote on bond issue of $18,000 for construction of school building.

Modesto, Cal.—Bond issue of $160,000 for construction of school buildings has been declared illegal.

Oregon City, Ore.—White Bros., architects, 804 Jefferson street, are preparing plans for a two-story warehouse building.

Orosi, Cal.—Bond issue of $20,000 for construction of building for Union high school has been voted.

Porterville, Cal.—New buildings, in addition to those already announced, are being planned and will cost approximately $200,000. The improvements, for which plans are now being made, include a 100-room brick hotel three stories in height, a 40-room brick apartment building, garage buildings, and a new 10-room residence. Dr. C. Edgar Smith is interested in the new hotel.

Ray, Ariz.—Bids will be received until noon, June 10, by Ray Consolidated Copper Co. for construction of sheet-steel pile-bulkhead and reinforced concrete wall, including about 500 cu. yd. concrete.

Redwood City, Cal.—Board of School Trustees has awarded contract for construction of a school building in El Cerrito to McLeran & Peterson for $13,000.

Salt Lake City, Utah.—Contract for construction of building for Liberty school has been awarded to Burg & Lundquist for $40,580.

San Dimas, Cal.—Election has been called for June 9 to vote on bond issue of $20,000 for construction of school building.

San Francisco, Cal.—Bids will be received until June 14 by Board of Public Works for construction of the following school buildings: Daniel Webster school, estimated cost $132,000; Paul Revere school, estimated cost $28,000.

Bids will also be received until the same time for construction of engine house No. 17. Estimated cost is $25,750.

Gutleben Bros., Call Bdg., have been awarded contract for the erection of hotel, general store, laundry, garage, and numerous lodges and small camps for the Desmond Supply Co. in the Yosemite Valley.

Seattle, Wash.—Bids will be received by the Port of Seattle Commission until June 14 for the construction of an extension to the Bell Street transit shed and for the construction of a transit shed at Smith's Cove. Estimated costs are $30,000 and $11,000 respectively.

Following bids were received by the Commission for the refrigeration of the apple storage warehouse: Filter Mfg. Co., $71,292; Securities Construction Co., $73,352; Harrington, Peters Co., $78,680; York Mfg. Co., $79,920.

Sidney, Mont.—Bids will be received by the city clerk until June 13 for construction of 8-room addition to Sidney school. Separate bids will be received for plumbing, heating, ventilating, and vacuum systems. Plans may be had upon deposit of $5. E. A. Kenoyer is chairman of the board.

Taft, Cal.—City clerk has been instructed to confer with architects relative to preparing plans and specifications for second story addition to the post-office to be used as city hall.

Tracy, Cal.—Bond issue of $60,000 for construction of building for union high school has been voted.

Vallejo, Cal.—The $80,000 school bonds, on which the people of the Vallejo school district recently voted, received a majority of only 72 votes. A two-thirds majority was necessary to carry them under the State law.

Washington, D. C.—Bureau of Yards and Docks, Navy Department, will receive bids until June 17 for construction of building at naval radio station at North Head, Wash. Plans from Bureau or from commandant of navy yard at Bremerton, Washington.

Woodland, Cal.—Special bond election will be held throughout Yolo county June 24 to vote on bond issue of $200,000 for construction of new county court-house.

MACHINERY AND SUPPLIES

Bishop, Cal.—Bids will be received until 8 p.m., June 12, by W. L. Smith, town clerk, for furnishing 200 to 400 ft. of 2½-in. fire-hose.

Seattle, Wash.—Bids will be received until 11 a.m., June 26, by C. E. Dole, purchasing agent Alaskan Engineering Commission, for furnishing a railway motor-car, locomotive crane, scrapers, sleds, wagons, frogs, switches, tinsmiths' machines and equipment. Particulars from circular No. 188, which may be obtained at U. S. Bureau of Mines, 506 Custom House, San Francisco.

Bids will be received until July 1 at U. S. Engineer Office for the purchase of one gantry cantilever-crane and equipment.

Washington, D. C.—Bids will be received until June 13 by Bureau of Supplies and Accounts, Navy Department, for delivery at Mare Island, Cal., of the following: miscellaneous quantity of brass phosphor bronze, and copper wire, schedule 9668; 240 ft. flexible metallic oil-hose, schedule 9687. Particulars from Purchasing Pay Officer, U. S. Navy Pay Office, San Francisco.

Bids will be received until June 20 by Bureau of Supplies and Accounts, Navy Department, for delivery at Mare Island, Cal., of six Diesel engines, schedule 9672. Particulars from Purchasing Pay Officer, U. S. Navy Pay Office, San Francisco.

MISCELLANEOUS

Crescent City, Cal.—Election has been called for June 27 to vote on bond issue of $100,000 for harbor development, funds to be used in connection with $390,000 government appropriation for this purpose.

Martinez, Cal.—Negotiations are being made with the Development Board by Charles Foster of San Francisco, to establish a ship-building plant at the foot of Smith or Ferry street, and by Vorheis Fireproof Wallboard Co. to remove its plant to Martinez.

Patterson, Cal.—Mineral Products Co. will erect a large plant.

San Francisco, Cal.—Union Iron Works Co. plans extensive improvements at its plant recently purchased from the United Engineering Works.

Seattle, Wash.—Bids will be received until June 9 by Board of Public Works for construction of steel water-tower and tank at Rainier Beach. Estimated cost is $30,000.

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Contracts Pending

Bids will be Received		See Issue of News Bulletin
June 5.	Anaconda, Mont., Sewers	June 5
June 5.	Hemet, Cal., Sewer	June 5
June 5.	Los Angeles, Cal., Sewer	June 5
June 5.	Los Angeles, Cal., Street Work	June 5
June 5.	Ontario, Cal., Street Work	June 5
June 5.	Redwood City, Cal., Road Work	May 15
June 5.	San Jose, Cal., Bridges	May 22
June 5.	San Jose, Cal., Road Work	May 22
June 5.	Santa Barbara, Cal., Road Work	May 15
June 5.	Santa Barbara, Cal., Road Work	May 22
June 5.	Sausalito, Cal., Street Work	May 22
June 5.	Seattle, Wash., Machinery	May 29
June 5.	Seattle, Wash., Road Work	May 22
June 5.	Waterville, Wash., Road Work	May 15
June 6.	Alameda, Cal., Buildings	May 29
June 6.	Renton, Wash., Bridge	June 5
June 6.	Centralia, Wash., Road Work	May 22
June 6.	Ephrata, Wash., Bridges	May 29
June 6.	Ephrata, Wash., Road Work	May 29
June 6.	Martinez, Cal., Buildings	May 8
June 6.	Plentywood, Mont., Bridge	May 29
June 6.	San Luis Obispo, Cal., Bridges	May 22
June 6.	San Luis Obispo, Cal., Road Work	May 15
June 6.	South Bend, Wash., Road Work	May 22
June 6.	Terry, Mont., Road Work	June 5
June 6.	Washington, D. C., Supplies	May 22
June 7.	Aberdeen, Wash., Irrigation	June 5
June 7.	Riverside, Cal., Road Work	May 29
June 7.	Seattle, Wash., Miscellaneous	May 29
June 7.	Sultan, Wash., Street Work	May 15
June 8.	Bakersfield, Cal., Road Work	May 22
June 8.	Oakland, Cal., Street Work	May 29
June 8.	Sierra Madre, Cal., Irrigation	May 29
June 9.	Berkeley, Cal., Power	June 5
June 9.	Los Angeles, Cal., Machinery	May 29
June 9.	Seattle, Wash., Miscellaneous	June 5
June 9.	Seattle, Wash., Sewers	June 5
June 9.	Seattle, Wash., Street Work	June 5
June 10.	Ray, Ariz., Building	June 5
June 12.	Baker, Ore., Building	May 22
June 12.	Baker, Ore., Building	June 5
June 12.	Bishop, Cal., Supplies	June 5
June 12.	Everett, Wash., Road Work	May 29
June 12.	Olympia, Wash., Miscellaneous	May 29
June 12.	Olympia, Wash., Road Work	May 29
June 12.	Redondo Beach, Cal., Sewer Pipe	June 5
June 12.	San Francisco, Cal., Machinery	May 29
June 13.	Eureka, Cal., Road Work	June 5
June 13.	Modesto, Cal., Bridge	June 5
June 13.	Salt Lake city, Utah, Street Work	May 29
June 13.	Washington, D. C., Building	May 29
June 13.	Washington, D. C., Supplies	June 5
June 14.	San Francisco, Cal., Buildings	June 5
June 14.	Seattle, Wash., Building	June 5
June 15.	Anchorage, Alaska, Miscellaneous	Apr. 10
June 15.	Denver, Colo., Irrigation	May 29
June 15.	Fowler, Cal., Street Work	May 15
June 15.	Hermiston, Ore., Irrigation	May 22
June 15.	Oakland, Cal., Sewer	June 5
June 15.	Oakland, Cal., Street Work	June 5
June 15.	Oretown, Ore., Sewers and Drainage	May 29
June 15.	Provo, Utah, Irrigation	May 15
June 15.	Ventura, Cal., Bridge	May 29
June 17.	Washington, D. C., Building	June 5
June 19.	Seattle, Wash., Road Work	June 5
June 19.	Montesano, Wash., Road Work	June 5
June 19.	San Jose, Cal., Bridges	May 29
June 19.	San Luis Obispo, Cal., Street Work	May 29
June 20.	Napa, Cal., Bridges	May 29
June 20.	Napa, Cal., Building	May 29
June 20.	Washington, D. C., Machinery	May 29
June 20.	Washington, D. C., Machinery	June 5
June 21.	Washington, D. C., Buildings	May 29
June 22.	Malta, Mont., Irrigation	May 22
June 22.	Salt Lake City, Utah, Sewer	June 5
June 23.	Oamaru, New Zealand, Power	May 29
June 26.	Seattle, Wash., Machinery and Supplies	June 5
June 26.	Upland, Cal., Street Work	June 5
July 1.	Seattle, Wash., Machinery	June 5
July 3.	Quincy, Cal., Bridge	May 29
July 3.	Redding, Cal., Bridge	May 29

Building Permits

MAY 25

Interior Finish—Cost $4700. Roman Catholic Archbishop of San Francisco, owner. NE Columbus Ave and Vallejo.

Four Story Brick Tenements—Cost $35,000. A. Rulfs, owner. W Leavenworth 76 N Sutter.

Restaurant Additions—Cost $3000. John Rosenfeld's Sons, owners. NW Austin and Polk.

MAY 26

One Story Frame Addition to Factory—Cost $2800. Pacific Hardware & Steel Co., owner. S Townsend 275 E 7th.

Two Story Frame Residence—Cost $15,000. J. C. Augsbury, owner. NW Balboa and 24th Ave.

Three Story Concrete Hotel—Cost $20,000. Vayssie Bros., owners. SW Post and Polk.

Two Story Frame Flats—Cost $3500. Mr. and Mrs. G. F. Munk, owners. N Francis 325 W Mission.

Two Story Concrete Lofts and Offices—Cost $9000. Fred Marriott, Jr., owner. S Minna 470 W Third.

Two Story Frame Flats—Cost $4500. Chas. Mitchell, owner. E 24th Ave 150 S California.

Two Story Frame Tenements—Cost $4500. Amalia Restler, owner. E Bryant 57 N Army.

MAY 29

Two Story Frame Dwelling—Cost $2500. F. Nelson, owner. W 27th Ave 175 N Irving.

Two Story Frame Dwelling—Cost $2500. F. Nelson, owner. W 27th Ave 200 N Irving.

Two Story Frame Dwelling—Cost $2500. F. Nelson, owner. W 27th Ave 225 N Irving.

Two Story Frame Dwelling—Cost $2500. F. Nelson, owner. E 28th Ave 115 S Lincoln.

Two Story Frame Dwelling—Cost $2500. F. Nelson, owner. E 28th Ave 193 N Irving.

Two Story Frame Dwelling—Cost $2800. N. J. Nelson, owner. E 20th Ave 200 S Clement.

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